FM 3-5

WAR DEPARTMENT

CHEMICAL WARFARE SERVICE FIELD MANUAL

TACTICS OF CHEMICAL WARFARE

July 20, 1942


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(For explanation of symbols see FM 21–6.)

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TACTICS OF CHEMICAL WARFARE

CHAPTER 1

TACTICS AND TECHNIQUE OF CHEMICAL ATTACK

SECTION I

GENERAL DOCTRINE

■ 1. INTRODUCTION.—*a.* Munitions other than chemical, such as high explosives and bullets, are effective solely because of their ability to destroy matériel and personnel. Chemical agents perform their missions by direct chemical action.

b. Chemical agents differ from other types of munitions in the varying lengths of time during which they are effective. The effective period of high explosives and bullets ends when the fragments come to rest, but the effective period of chemicals may continue for hours or days.

c. The cover sought for protection against the fire of bullets and high explosives, such as defilade and trenches, affords only very limited protection against chemical attack. The chemical agent permeates the atmosphere and reaches men behind concrete parapets and buildings, in trenches, or wherever else they may be.

d. One type of agent may be employed to hamper an enemy attack and increase the risk involved; another reduces the effectiveness of hostile fire and thus speeds our own advance. The shock action of the enemy's armored force attack may be reduced by breaking up and disorganizing it through the appropriate use of chemical agents.

e. Chemical agents can be used effectively in most operations. Used properly, they can add materially to the effec-

tiveness of all other weapons. Therefore, it is the purpose of this manual to indicate to the various arms the appropriate tactical use of the several types of chemical agents.

■ 2. TACTICS AND TECHNIQUE —*a. Tactics.*—The determination of when and where to use chemical agents, and the selection of the proper agent and weapon, constitute the tactics of chemical warfare. This requires an understanding of the power and limitations of the agents and weapons available, and the practical difficulties involved in placing the fire where desired.

b. Technique.—The methods by which chemical agents are projected constitute the technique of chemical attack. They depend upon an intelligent application of the laws of chemical dispersion and cloud travel to the particular problem at hand in order to accomplish the mission with a reasonable expenditure of matériel.

■ 3. DOCTRINES OF EMPLOYMENT.—Chemical agents are used against suitable targets in lieu of or to augment other types of munitions. Although the introduction of chemicals into warfare has influenced tactics and technique, it has not changed any of the doctrines upon which combat is based. Chemical warfare has intensified several of these doctrines, however, and has established additional ones than govern chemical employment.

a. Doctrines of combat and chemical warfare.—(1) *Surprise.*—An enemy who has been given an opportunity to prepare to meet a chemical attack will be able to reduce its effectiveness. Therefore, the intention to use chemicals should be concealed, and attacks made when the enemy is most likely to be caught unprepared. Sometimes the use of chemicals can even be camouflaged advantageously by adding smoke or high explosives. Surprise may also be brought about by the use of new agents, new munitions, or new means of dissemination.

(2) *Simplicity.*—Complicated plans for the employment of chemicals should be avoided. Simple and direct plans and methods with prompt and thorough execution are often decisive in the attainment of success.

(3) *Mass.*—To be effective, chemical agents must be fired in certain quantities per unit of target area. Desired results

FIGURE 1.—Surprise spray attack.

will not be obtained by firing a quantity that will not produce an effective concentration. A few chemical shells are better than none, but where there is a lack of sufficient ammunition to cover all targets with the desired amount, the available shells should be massed on fewer targets rather than distributed over all. Since the highest concentration is obtained normally during and immediately after the time of fire, weapons firing chemicals should, as a general rule, be massed on targets in turn rather than have their fire distributed over all targets simultaneously.

(4) *Cooperation.*—Cooperation demands coordination. Chemical operations must be carefully coordinated with other operations. The effect of chemical agents is not confined to the impact area, nor generally to the duration of fire, as in the case of high explosive. Unless properly coordinated, the use of chemicals in cooperation with one unit may seriously hamper another unit. Inasmuch as chemical munitions are fired by more than one arm, and as they are fired in lieu of, or in conjunction with, other types of munitions, there must be careful coordination of all supporting fires.

(5) *Economy of force.*—In conjunction with the previous one, this doctrine demands that the weapons most particularly suited to a given mission be used in its execution. Economy of force is especially exemplified in the use of harassing agents. They produce their effect in low concentrations and can be used effectively with HE shells against personnel. Such employment increases the effectiveness of the high explosive by putting the additional burden of masking on personnel already endangered by the effect of the high explosive.

b. Special doctrines for chemical employment.—The four doctrines which follow are discussed in pertinent paragraphs of sections III and IV of this chapter.

(1) *Effects of weather and terrain.*—All weather and terrain factors must be considered in any chemical operation.

(2) *Employment of chemical agents.*—A chemical agent should not be fired upon a target that will be occupied by friendly troops during the effective period of the agent.

(3) *Employment of persistent agents.*—Persistent agents may be used against occupied or unoccupied targets.

(4) *Employment of nonpersistent agents.*—Nonpersistent agents should be used only against occupied targets.

SECTION II

CHEMICAL AGENTS AND MATÉRIEL

■ 4. CHEMICAL AGENTS.—Chemical substances used in war which, through their ordinary chemical properties, produce a toxic or irritant effect on the body, a screening smoke, or an incendiary action, are called chemical agents. They are classified according to their tactical uses, persistency, and physiological effects. While other classifications may be applied to them, such as chemical composition and physical state, the three previously mentioned are of greater importance in the tactics of chemical warfare. The chart (fig. 2) shows the classifications of several chemical agents. TM 3–215 gives additional technical information.

■ 5. TACTICAL USE.—The tactical classifications of chemical agents are casualty, harassing, screening, and incendiary. Many agents have a principal tactical application and additional uses by reason of secondary effects.

a. Casualty agents.—These are chemical compounds which are highly toxic in relatively low concentrations. Their physiological action is usually directed against the respiratory system, the circulatory and nervous systems, or the skin and eyes. Some may have more than one physiological effect. In general, casualty agents, when effective, may be expected to incapacitate personnel for periods varying from a few days to a month or longer. However, the effect produced is dependent upon the quality of the enemy's protective devices, his gas discipline, his willingness to risk casualties to gain an objective, and the technique of our chemical operation.

b. Harassing agents.—These have a powerful irritating effect which is immediately, but temporarily, incapacitating to personnel inadequately protected. They are generally toxic but are of such nature that it is not possible to produce lethal concentrations under field conditions. The irritant effects are produced by using relatively small quantities of chemicals, thus making is possible economically to force enemy personnel to wear gas masks for long periods.

c. Screening agents.—These are principally used for their screening properties, such as screening or blanketing to prevent observation. They form smoke or artificial fog.

d. Incendiary agents.—Agents employed primarily to ignite combustible substances are termed incendiary agents. There are two general types of incendiaries. One is the scatter type, which disperses a large number of small burning pieces over a relatively large area in order to initiate fires at many places simultaneously. The other is the intensive type which concentrates its heat and flame within a limited space in order to set fire to heavy construction and targets generally more difficult to ignite.

■ 6. PERSISTENCY.—This property of chemical agents is inseparable from any tactical consideration in chemical warfare. The effectiveness of all agents continues for a period of time after their release. The persistency classifications indicated in figure 2 are those of the agents themselves and not necessarily of a chemically filled munition. The persistency of an agent may be altered by the use of shell bursters having greater or less explosive force or by adding substances which change the volatility of the filling.

a. Nonpersistent agents are those which remain effective in the open, for a period of 10 minutes or less, at the point of dispersion.

b. Persistent agents are those which remain effective for more than 10 minutes at the point of dispersion.

■ 7. PHYSIOLOGICAL CLASSIFICATION.—The physiological effect of any toxic agent is dependent upon the time of exposure and the concentration. Some agents act rapidly, the effect being almost instantaneous, while others have a delayed action. This delay varies with the agent and in some cases with physical activity after exposure. Many agents have several physiological effects as indicated in figure 2.

a. Lung irritants.—These agents act upon the respiratory tracts. Casualties resulting from exposure to high concentrations frequently result fatally, especially if any physical activity is engaged in following exposure. The gas mask protects the respiratory system from all known chemical warfare lung irritants.

b. Vesicants.—Vesicant agents affect the skin, respiratory system, and the eyes through the action either of the liquid or the vapor, causing blisters and incapacitating men for varying periods of time. The severity of the effect is de-

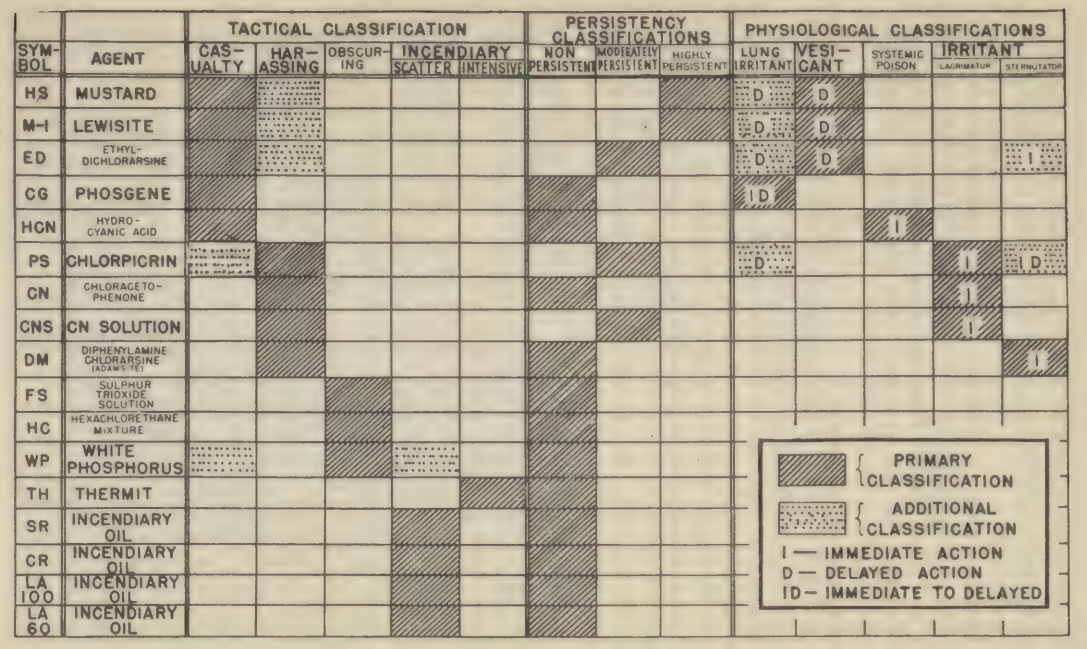


FIGURE 2.—Classification of typical chemical agents.

pendent upon the period of exposure and the vapor concentration or the amount of liquid in contact with the skin. Vesicant action is delayed from 30 minutes to several hours after exposure.

c. Systemic poisons.—These agents act upon the nerves and circulatory system. They are rapid in their action and casualties are often fatal. However, they have never been successfully used on the battlefield due principally to inability to build up effective concentrations. Successful tactical use of them may still develop.

d. Irritant agents.—This classification includes the lacrimators and sternutators. Lacrimators affect the eyes, causing a copious flow of tears and interference with vision. Their action is rapid but of short duration after removal from a contaminated atmosphere. Sternutators affect the nasal passages and digestive system, and cause sneezing and nausea. Their action is also rapid, but recovery is much slower than in the case of lacrimators. Exposure to irritant agents temporarily incapacitates personnel.

■ 8. METHODS OF DISSEMINATION.—Weapons and munitions for the dissemination of chemical agents are generally available to all arms, and vary in nature. Their military characteristics are given in appendixes V and VI.

a. Static weapons.—Chemical weapons that are employed to disperse chemical agents at the point of installation are called static weapons. They are of two types: first, those employed to release large clouds of nonpersistent gas from friendly forward positions at a time when the wind will carry the cloud to the desired hostile position; and, second, those employed to disseminate persistent gas for the contamination of ground or demolitions at the point of emplacement. The portable chemical cylinder and irritant gas candle are included in the first class; the chemical land mine is the principal weapon of the second class.

b. Projectiles: short range.—Chemical hand grenades are, in effect, short range projectiles. Irritant gas and smoke are provided for the standard chemical grenade. Special antitank grenades have smoke and incendiary fillings.

c. Projectiles: medium and long range.—Infantry and chemical mortar shells provide means of projecting gas and screen-

ing smoke to ranges up to about 2,500 yards. Chemical shells are provided for light and medium artillery and for the 155-mm gun. By these means chemical agents can be projected to ranges of about 22,000 yards.

d. Air force matériel.—Bombs and spray tanks are employed by the air force to disseminate chemical agents. Smoke, gas, and incendiaries are projected by these means.

SECTION III

EFFECT OF WEATHER AND TERRAIN ON CHEMICAL AGENTS

■ 9. WIND.—*a. Effect upon nonpersistent agents.*—Since nonpersistent agents are released in a gaseous state, they are greatly affected by the direction, velocity, and steadiness of the wind.

(1) *Direction.*—When cloud gas is employed, the direction of the wind must be such that it will take the agent to the target without carrying it into any area occupied by our own troops. When placing chemicals upon distant areas, the direction is not so important unless the gas is used in large quantities or the action is long sustained. In such case there is a possibility that the gas or smoke may be brought back to our position in a high enough concentration to interfere with our observation or to require masking by our troops.

(2) *Velocity.*—With cloud gas the wind velocity should not be less than 3 miles per hour. Winds of a low velocity are likely to be variable. When the agent is delivered by artillery, mortars, projectors, or aircraft, this lower limit of wind velocity need not be considered unless the target is very close to our own lines. Wind velocity should not be over 12 miles per hour. Winds of high velocity tear clouds apart and dissipate the concentration. The higher the wind velocity the faster a given wave or cloud will pass over the enemy's position, the shorter the time he will be exposed to it, and the less effective it will be. In a high wind more agent is required. High wind velocities tend to cause turbulence and eddies over trenches and valleys. The cloud may be so torn apart that groups of the enemy will be left in gas-free "islands" and escape its effect. The upper limit of 12 miles per hour

applies to artillery, mortar, projector, and aircraft operations as well as cylinder attacks.

b. Effect upon persistent agents.—With persistent agents the liquid rather than the vapor is usually relied upon for physiological effect. These agents, therefore, are not dependent upon wind velocity and direction to the same extent as are nonpersistent agents. However, wind velocity will affect their persistency. Low wind velocity will permit the vapor to saturate the air above the contaminated area, thus retarding the rate of evaporation and increasing the persistency. Wind velocity and direction should be considered because of the possibility that dangerous vapor concentrations may be carried from the contaminated area to friendly troops. When there is likely to be wind from unfavorable directions, persistent agents should not be used in large quantities on areas closer than 1,000 yards to any position friendly troops are expected to occupy. If the wind direction will not be unfavorable during the period of effective persistentcy of the agent used, or during the period of occupation, this 1,000 yard limitation does not apply.

c. Effect upon smoke.—Wind direction, velocity, and steadiness affect screening smoke in the same manner as nonpersistent agents.

d. Effect upon incendiaries.—High winds create a favorable condition for the use of incendiaries since they fan the fire. However, the direction of the wind must be taken into account to guard against spreading the fire to our own locations.

■ 10. TEMPERATURE.—*a. Effect upon nonpersistent agents.*—High temperatures cause the air near the ground to become heated and thus to rise and be displaced by cooler, heavier air, thereby causing convection currents. These will cause the agent to rise rapidly over the heads of the enemy and to mix with large quantities of air, thus lowering the concentration. Convection currents are especially prevalent in the afternoon over dry or plowed ground free of vegetation. On the other hand, on days when the temperature is low, the lower layers of the air will remain cool and there will be less tendency for an overturning of the atmosphere. The length of time that a definite amount of agent will give an effective cloud is thus increased. High temperatures which

usually occur on bright, sunny days produce conditions unfavorable to the success of nonpersistent gas attacks. Periods from midnight to dawn are the most favorable.

b. Effect upon persistent agents.—Temperature is an important consideration in the use of persistent agents only because of its effect upon the period of persistency. High temperatures increase the rate of evaporation and thereby decrease the period of effectiveness. This is also an important consideration when these agents are used against troops with inadequate protection as the vapor will cause casualties under these conditions. Although a low temperature will prolong the effective period of these agents, it may also approach their freezing point and consequently minimize their action.

c. Effect upon irritant and screening smokes.—So far as the formation of the original cloud is concerned, smokes are comparatively free from the influence of atmospheric temperature. The cloud once formed is affected in the same way as clouds of nonpersistent agents. Convection currents lift the cloud high in the air and often prevent satisfactory screening. Such currents are not so strong in high winds as in light winds inasmuch as the former rapidly mix the warm surface-heated air with the surrounding cooler air.

d. Temperature effects at night.—(1) During the daytime the temperature over a limited area is about the same unless there are marked changes in topography or soil. On days with much sunshine and a low wind velocity, the lower points, particularly those in narrow valleys, may be a few tenths of a degree warmer than the upper parts of the area. At night the layer of air next to the ground becomes cooler and denser, and flows like water into valleys and places of low elevation. If the wind is unable to remove these pockets of cool air, a marked variation in temperature over a limited area will be found. For every limited area there will be a critical value of wind velocity, which for most areas is probably not far from 3 miles per hour. As long as the wind velocity remains higher than 3 miles per hour these pockets of air will be removed and mixed with air at other points, and no variation in temperature will be found. Since the question of variation in temperature depends upon the interplay between the flow of cooler air and the ability of the wind to

remove these pockets of cool air, the variation will depend not only upon the elevation but also upon the openness of the valleys, their direction, the roughness of the surface, and the direction of the wind.

(2) Because of the tendency of surface air to cool at night and flow into valleys and depressions, such places in the vicinity of gassed areas will, on calm nights particularly, be likely to contain dangerous concentrations of toxic agents. This matter should receive careful consideration in the projection of chemicals as well as in the disposition of troops.

■ 11. EFFECT OF CLOUDS.—Clouds have no direct effect on any chemical agent. They attain their effects indirectly through their control over temperature. They shut off the sun's rays and thus shield the surface of the earth from some of the heat of the sun. Clear, hot, sunshiny days are favorable to convection currents and to a rapid rise of the agent from the ground. An overcast or cloudy day is less favorable for the development of rising air currents, and the agent will stay near the surface of the earth for a longer period. A sunny day, then, is unfavorable to the success of chemical attacks and a cloudy day is favorable.

■ 12. HUMIDITY.—Obscuring smokes and some toxic agents hydrolyze with the moisture in the air and form new compounds or decompose. The resulting hydrolysis destroys the toxicity of some gases but increases the effectiveness of most screening smokes.

a. Effect upon nonpersistent agents.—Phosgene hydrolyzes quite rapidly. However, the extent of this action will depend upon the amount of water vapor in the air and upon the temperature. Thus the first part of a phosgene cloud moving through an extremely damp atmosphere will have a lower content of phosgene than the following portions of the cloud.

b. Effect upon persistent agents.—The humidity of the air will have no appreciable effect on the persistent agents regardless of how they may be released.

c. Effect upon screening smokes.—Since most screening smokes are produced or aided by hydrolysis, they are made more effective with high humidity. If humidity is low, a satisfactory screen will require a greater quantity of agent.

■ 13. PRECIPITATION.—*a. Effect upon nonpersistent agents.*—The concentration of clouds of nonpersistent agents is immediately lowered by rain. The gases are washed from the air. Phosgene is quite readily hydrolyzed, forming products which are ordinarily not toxic in the field. Hydrolysis, however, is not an important factor with other nonpersistent gases. Snow and hail, to a lesser extent, act in the same way.

b. Effect upon persistent agents.—Heavy rains in combination with high temperatures greatly reduce the persistency of mustard gas. Lewisite is readily hydrolyzed but forms a toxic vesicant solid.

c. Effect upon screening smokes.—Light precipitation, fogs, and mists are favorable for use of screening smokes since much of the obscuring power of smoke is due to the formation of hydrolyzed particles. Fog, light rain, or mist reduce the amount of smoke necessary. This is due both to the obscuring power of the mist and to the increased efficiency of the smoke in the damp air. On the other hand, heavy precipitation tends to beat the smoke cloud down and wash it from the atmosphere.

d. Effect upon incendiaries.—Precipitation ordinarily is an unfavorable factor in the use of incendiaries because it wets the combustible material and slows up ignition and spread of the fire.

■ 14. ATMOSPHERIC PRESSURE.—*a.* Pressure has no appreciable effect upon any of the chemical agents except so far as it controls vertical air currents and winds. The winds tend to move from highs toward lows, and the greater the change in pressure the stronger the winds which may be expected.

b. Rising air currents, often formed when the pressure is low, tend to follow the center of the low area. Rising air currents are unfavorable since they cause gas clouds to be carried upward and rise over the heads of the enemy.

c. Descending air currents are often found when the pressure is high, and they tend to accompany high areas in their movements. In the presence of these currents the air tends to carry the agent downward and thus holds the cloud close to the surface of the earth, where it is most effective.

■ 15. CHEMICAL CLOUD TRAVEL.—Chemical agents are usually disseminated as vapors or as small solid or liquid particles. When each molecule is free to move according to the gas laws, we have a true gas, while the smoke particles or "aerosols" follow the laws governing colloids. Therefore, chemical clouds are of two types: one in which vapor is mixed with air (gas clouds), and the other a suspension of extremely small liquid or solid particles in air (smoke clouds).

a. Gas and smoke compared.—A liquid changing into a gas removes heat from the air during vaporization, while smoke materials either burn or hydrolyze in air, thus generating heat. The result is that immediately downwind from the source of a vapor cloud the air is cooled, while immediately down wind from a source of smoke the air is heated. Therefore, the gas cloud tends to follow the earth's surface in the absence of convection currents or other factors which might cause it to rise. The smoke cloud initially tends to rise and, after cooling, falls back to the earth in the absence of convection currents or other factors which might cause it to remain at a higher level.

b. Lateral spread.—When either vapor or smoke is released, the cloud is blown from side to side by shifting air currents, which cause a lateral spread as the cloud moves down wind. In steady winds this spread amounts to about 15 percent of the distance traveled, while for ordinary conditions the spread is about 20 percent of the distance from the source. Under very unfavorable conditions, when the wind is rapidly changing direction, or in a fish-tailing wind, the spread is very great. (See fig. 3.)

c. Drag effect.—Wind currents carry chemical clouds along the ground with a rolling motion, since the velocity of the wind is less near the ground. This rolling motion causes the cloud to stretch out in length. Increase in the length of the cloud is called the "drag effect." For clouds released on the ground the drag amounts to about 10 percent of the distance traveled over grass, plowed lands, or over water, and to about 20 percent for gently rolling terrain covered with bushes, growing crops, and small patches of scattered timber. (See fig. 3.) In heavy timber the drag effect is much greater. When a cloud is released from an airplane at 50 feet above the ground a much greater drag occurs than if the agent is

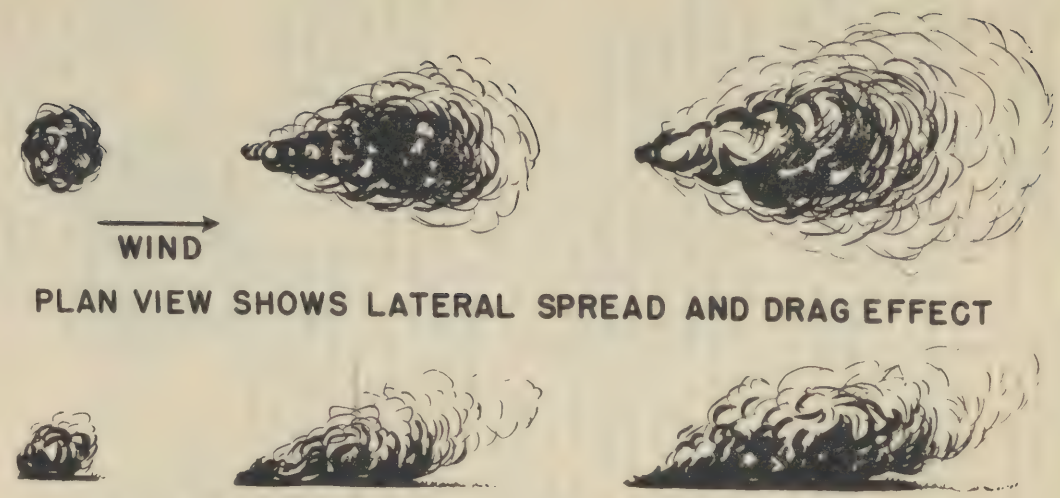


FIGURE 3.—Travel of smoke puffs under average conditions.

released from a stationary source or projectile impact. This drag is usually equal to 50 percent of the distance traveled for the first 1,000 yards and 25 percent of the distance traveled thereafter.

d. Vertical rise.—(1) *Smoke.*—Each smoke particle acts like a toy balloon, rising when heated and falling when cooled below the temperature of the surrounding air. Heat is transferred to the smoke particles in bright sunshine by radiation. When the ground is dry and warmer than the air and when the sun is shining brightly, convection currents add to the temperature of the smoke and give it additional vertical rise. (See fig. 3.)

(2) *Gas.*—Convection currents give the same rise to gas as to smoke clouds, but radiation affects the smoke particles more strongly. Hence, convection currents will cause both smoke and gas to rise, the former more than the latter.

e. Dilution factors.—Under ordinary conditions five main factors cause dilution of chemical clouds. In order of importance these factors are—

(1) Vertical rise.
(2) Lateral spread.
(3) Drag effect.
(4) Settling and adsorption.
(5) Destruction of the agent through hydrolysis.

f. Summary.—Spread, rise, and drag effect on the travel of chemical clouds are shown diagrammatically in figures 3 and 4. These values can be calculated both for gas and for smoke. For use in the field the general rules given below apply for about the first 1,000 yards of travel. Rates of dilution are affected by various weather factors as follows:

(1) *Favorable conditions.*

Sky	Heavily overcast.
Time of day	Night or early morning.
Terrain	Level fields or water.
Ground	Colder than air.
Winds	3 to 12 miles per hour for smoke dispersed from projectiles.
	Steady, 0 to 4 miles per hour for gas fired from projectiles.
	3 to 8 miles per hour for smoke or gas fired positionally.

FIGURE 4.—Plan of smoke cloud.

Under the above conditions smoke clouds may be expected to have the following spreads:

Vertical rise_____ 10 percent of distance traveled.
Lateral spread___ 15 percent of distance traveled.
Drag effect_____ 10 percent of distance traveled.

Gas clouds will have a vertical rise of 3 percent of the distance traveled, but the same drag and lateral spread as smoke.

(2) *Average conditions.*

Sky_____ Partly overcast.
Time of day_____ Midmorning, late afternoon.
Terrain_____ Moderately rolling farm lands.
Temperature_____ Air and ground nearly same temperature.
Winds_____ Slightly shifting, 4 to 9 miles per hour for gas.
Slightly shifting, 8 to 12 miles per hour for smoke.

Under the above conditions the spreads for smoke clouds are: vertical rise, spread and drag effect, each 20 percent of the distance traveled. Gas clouds will have a vertical rise of 10 percent of the distance traveled but the same drag and lateral spread as smoke.

(3) *Unfavorable conditions.*

Sky_____ Clear.
Time of day_____ 11 AM to 4 PM.
Terrain_____ Broken or wooded.
Ground_____ Much hotter than air.
Winds_____ Variable, or over 9 miles per hour for gas. Variable, or over 12 miles per hour for smoke.

Under the above conditions the dilution rates of both smoke and vapor clouds may be as great as—

Vertical rise_____ 35 percent of distance traveled.
Lateral spread__ 50 percent of distance traveled.
Drag effect_____ 20 to 40 percent of distance traveled.

(4) *Rise, spread, and drag effect.*—The following table summarizes the spread, rise, and drag effect for various conditions:

Condition	Rise, percent		Spread, percent		Drag, percent	
	Gas	Smoke	Gas	Smoke	Gas	Smoke
Favorable	3	10	15	15	10	10
Average	10	20	20	20	20	20
Unfavorable	35	35	50	50	20–40	20–40

This table is reasonably accurate for the first 1,000 yards of travel.

■ 16. EFFECT OF TERRAIN.—The effect of terrain on gas attacks may be briefly summed up as follows: Tall grass, bushes, trees, and buildings retard the movement of mixed air and gases, thereby making them more persistent. In dugouts, cellars, deep trenches, hollows, and other inclosed spaces, gases persist longer than in the open. Most war gases, being heavier than air, tend to flow into gullies and valleys, leaving the tops of hills comparatively free. The effect of gases from projectiles will be diminished in marshy ground or in a shelled area where the craters are full of water. The effectiveness of gas clouds, however, is not appreciably reduced by passage over water. Both gas and smoke are partially adsorbed by the ground and vegetation.

SECTION IV

TACTICAL EMPLOYMENT OF CHEMICAL AGENTS

■ 17. GENERAL PRINCIPLES.—*a. Nonpersistent casualty agents.*—(1) These agents are fired for casualty effect only upon occupied targets. In the selection of such targets due consideration must be given to the direction of the wind and the distance of each target from friendly troops.

(2) High concentrations on fairly large areas are the most effective in producing casualties. Ability of toxic gas to produce casualties is directly proportional to the concentration multiplied by the time of exposure. Nonpersistent gas concentrations on small areas soon become ineffective due to dilution. (See app. III.)

(3) Surprise is a most essential factor in securing casualties with nonpersistent gas. High concentrations placed un-

expectedly on an enemy will produce casualties before masks are adjusted. Hence the most suitable time to fire these agents is during the night when men are sleeping.

(4) Nonpersistent gas is especially effective in woods, towns, and defiladed valleys not readily reached by other weapons.

(5) The required quantity of a nonpersistent agent must be fired in the minimum of time, with 2 minutes as the maximum. Rapid vaporization of the agent requires that it be fired in the shortest possible time to obtain maximum concentration. At the end of 2 minutes a well-trained command will have adjusted its masks and thus obtained protection from a nonpersistent gas attack.

(6) Nonpersistent agents may be used up to 30 minutes prior to the time the area fired upon is to be occupied by our troops.

(7) Weather factors influence the use of nonpersistent agents and must be considered in planning their employment.

b. Persistent casualty agents.—(1) Persistent casualty agents are employed in combat for two general purposes:

(*a*) To cause casualties in the hostile forces.

(*b*) To deny ground through the threat of casualties.

(2) Heavy concentrations of persistent vesicants will force evacuation of an area. These agents can therefore be effectively used for counterbattery fire, and for the interdiction of roads, defiles, and areas.

(3) Due to their persistency, an effective concentration can be fired on an area during a more extended period than is required for nonpersistent agents. To secure maximum casualties on occupied areas, the concentration should be fired within a period of 10 to 20 minutes.

(4) A chemical agent should not be fired on a target that will be occupied by our own troops during the period the agent is effective. Highly persistent agents can therefore be used preparatory to an attack to secure casualties or to neutralize strong positions only in such situations where these areas can be avoided by attacking troops. It should be borne in mind, however, that since attacking troops seek to avoid gas contaminated areas, employment of persistent gas several hours before an attack is launched may disclose prematurely the scheme of maneuver.

(5) Persistent vesicants are very effective when fired upon wooded areas. Air bursts cause the areas to be sprayed by the liquid, thus covering personnel and making all vegetation dangerous. Areas covered with small brush or heavy vegetation, if well contaminated with the persistent vesicants, are difficult for personnel to occupy or to cross without coming in contact with the agent.

(6) Persistent vesicants are not suitable for use where immediate casualty effects are desired.

(7) The effectiveness of highly persistent agents is reduced during low temperatures. At such times casualties will be obtained from the firing of these agents only when direct contact with the liquid agent results.

(8) Persistent vesicants should be distributed over the target by weapons that will produce the greatest number of infected points with a given quantity of agent. Inasmuch as every point where a vesicant has been projected is a source of danger, the greater the number of points the greater the chances of securing casualties. One 155-mm artillery shell will deliver approximately the same quantity of agent as nine 75-mm artillery shells, but the contaminated points produced by the latter will be much harder for enemy personnel to avoid. Since for each pound of agent fired the small projectile produces a greater surface for vaporization, the gas concentration in the air is higher and the persistency of the agent is decreased. Where it is desired to keep the area contaminated for a long period of time, the period between shoots can be longer when the larger projectile is used.

c. Harassing agents.—(1) Irritant gases for harassing hostile personnel are effective in extremely low concentrations and produce immediate results. They are, therefore, economically employed instead of the casualty agents to force the enemy to wear the gas mask for long periods of time, thus hindering his operations and lowering his morale.

(2) Harassing agents are most effective when fired upon troops in movement or performing hard labor, upon gun crews and fire control personnel in action, or upon personnel trying to sleep.

(3) Small quantities of irritant gases fired upon the enemy at frequent intervals throughout the night are effective in disturbing rest and lowering morale.

(4) Irritants of the DM type are most effective when employed against an enemy not equipped with gas masks or equipped with masks containing poor filters. Personnel affected by this agent will be forced to remove masks on account of sneezing and vomiting, in which case they may be subject to other agents, principally of the nonpersistent casualty type.

d. Screening smoke.—(1) Smoke is used in combat for two general tactical purposes: first, to deny information to the enemy of activities on the battlefield; and, second, to reduce the effectiveness of hostile fire.

(2) In the employment of smoke, wind conditions and the question whether it will interfere with our own operations, or those of other friendly units, should be carefully considered. When the wind velocity is more than 12 miles per hour, the smoke is so rapidly dispersed that it is difficult to maintain an effective screen. With an unfavorable wind direction, smoke that is employed to aid one unit may interfere with the operations of adjacent units.

(3) When used to reduce the effectiveness of hostile fire, the smoke must be placed directly upon or closely up wind from the hostile firing lines. Other factors being equal, our small-arms fire will be four times as effective as the enemy fire.

(4) Smoke is effectively used in the following types of action:

(*a*) To screen an advance against a hostile position.

(*b*) To protect a flank exposed to enfilading fire.

(*c*) To support local attacks on machine guns or similar fire.

(*d*) To screen indefinite targets, such as machine guns or antitank guns whose general location is known.

(*e*) To screen movements within the friendly position.

(*f*) To blind hostile observation posts.

(*g*) To deceive the enemy as to the location of the main attack.

(*h*) To cover river crossing operations.

(*i*) To cover withdrawals.

(*j*) To aid in counterattacks.

(5) Smoke used within our own lines will draw fire. Therefore, it should never be used immediately in front of or within our own lines if it can be avoided.

(6) In the defense, the use of smoke is limited to screening distant operations and to supporting counterattacks.

(7) Although smoke (WP) is used primarily for screening purposes, its casualty value should not be overlooked. When placed directly upon the hostile position, the particles of white phosphorus thrown from bursting shell will cause many casualties.

e. Incendiaries.—Incendiaries are employed in combat to destroy hostile supplies, equipment, and installations by burning. The scatter type incendiary is suitable for employment against tactical and strategic objectives. The intensive type is suitable for strategic objectives only.

(1) *Scatter type.*—White phosphorus is employed against enemy personnel for direct casualty and morale effect, and to set fire to woods, wooden structures, and other combustible material (fig. 5). Oil incendiary munitions produce more heat than white phosphorus and are effective in driving personnel out of natural cover, wooden buildings, and woods when, due to weather conditions, these targets cannot be ignited readily by white phosphorus. Special incendiary material loaded into hand grenades or other suitable containers may be effectively employed against armored vehicles.

(2) *Intensive type.*—Large scale operations with this type of incendiary are most effective against strategic objectives such as large ammunition and supply installations in rear areas of the theater of operations, and munition factories and war industrial centers in the zone of the interior.

(3) *Use with other agents.*—Neither type incendiary should be used with other agents. Nonpersistent agents will be broken up and dissipated by the heat of the incendiary, and persistent agents will be destroyed by it. The incendiary might be used in an operation following a nonpersistent gas attack.

■ 18. CHEMICAL AGENTS IN THE OFFENSIVE.—*a. Nonpersistent casualty agents.*—(1) Since the agents of this group dissipate rapidly when released in the open, they may be used freely in

FIGURE 5.—Burst of white phosphorus filled shell.

the offensive. They are most effective in producing casualties if fired between 1:00 AM and 3:00 AM when the enemy is likely to be least alert. However, if surprise can be obtained, hostile defensive fires may be more effectively disrupted at H-hour if the gas is fired immediately prior thereto.

(2) Suitable targets in the offensive for nonpersistent agents projected by chemical shell are strongly held defense areas and areas occupied by supporting elements.

(3) Gas cloud attacks released from our lines by means of cylinders are limited to situations where close contact and temporary stabilization exist. In such situations and with a favorable wind, heavy concentrations released over a wide front will be effective not only against forward positions of the enemy but also against his supports and reserves. They should normally be used against the most strongly held sections of the enemy lines.

b. Persistent casualty agents.—(1) Persistent casualty agents are used in the offensive to cause casualties among the enemy and to force him to evacuate, or to prevent his use of, important positions and routes of communication. Use of these agents in the offensive, however, is limited by the general rule that no agent should be used upon an area that is to be occupied by our own troops during the effective period of the agent. Therefore, they should be used only on areas that can be avoided in the advance or on areas beyond the objective.

(2) Small areas within the zone of attack which are so strong that their capture by assault methods will result in excessive casualties to the attacking force are suitable objectives for persistent gas attacks. Such areas should be so thoroughly contaminated as to force evacuation by the enemy, and their location should be made known to all concerned in order that they may be avoided in the advance. Routes of communication in rear of the enemy front lines or on his flanks may also be so thoroughly contaminated as to prevent their use by reserves.

(3) Positions on the flanks that may be used by the enemy for supporting fires can be neutralized prior to the attack, thus eliminating opposition from this source and releasing to some extent troops that would normally be sent against these positions.

(4) Persistent casualty agents are effectively used for counterbattery. When fired in heavy concentrations on battery positions they cause casualties in gun crews, contaminate matériel, and force evacuation of positions.

(5) Persistent casualty agents can be freely used by aircraft, either in bombs or as spray, on rear areas beyond our immediate objective to interdict roads and defiles, to neutralize important areas, and to contaminate supplies and service installations.

c. Harassing agents.—Nonpersistent irritant agents are used directly against personnel in much the same manner as nonpersistent casualty agents. They are particularly effective when used on hostile positions on which the enemy is working or when fired over long periods on hostile personnel trying to sleep. When close contact is maintained with the enemy for several days, these attacks may be maintained intermittently day and night. They may be used just prior to and during the attack, either alone or mixed with screening smoke, to hinder defensive operations.

d. Screening smoke.—(1) The principal use of smoke in the offensive is to cover the advance of our attacking troops. This denies the defender definite information of our movements and prevents him from using aimed fire. Smoke may be used to cover the advance of small units making an attack against a machine gun nest or combat group, or it may be used across a broad front to cover the advance of battalions and regiments. When so used, it should be placed directly on or close in front of the defender's front lines and maintained from the time our troops come under effective small-arms fire until they reach assaulting distance (fig. 6).

(2) White phosphorus, in addition to being a casualty agent, has an adverse effect on the morale of troops. Placing this agent upon the defender's line not only gives the fire superiority produced by the smoke but additional casualty and morale effect as well.

(3) Smoke may also be used to cover the movements of troops within our lines, thus preventing the enemy from discovering our dispositions and probable intentions. When so used, it may be placed either upon the enemy lines or between the enemy lines and our own. It preferably should

be placed upon the enemy lines, the same as in the attack, so that he may not readily discover the reason for its use.

(4) Smoke may be used to protect a unit from enfilade fire (fig. 7).

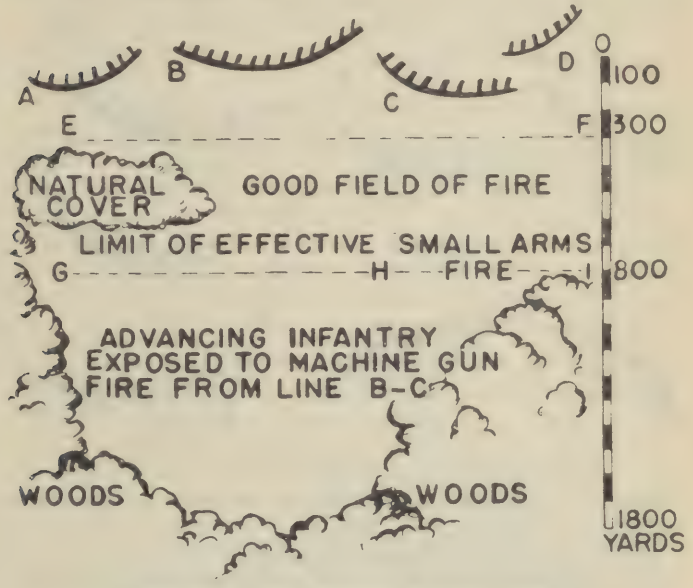


FIGURE 6.—Smoke to cover infantry attack.

Natural cover available for the attack on the hostile line A–B. No smoke is needed.

No cover available for the attack on line B–D. Smoke is needed after crossing line G–I.

The area in rear of the line G–H is exposed to machine-gun fire from the line B–C. If ammunition is available, the line B–C should be screened during the advance across this area and the line B–D screened during the advance from the line G–I to the assault position. Fire must cease when the advance is in the vicinity of the line E–F.

(5) Smoke is employed in the offensive to blind hostile observation. This will include general observation of our dispositions and movements as well as the observation, adjustment, and control of opposing artillery fire. Artillery

is employed to screen distant observation; chemical and infantry mortars are employed against close observation.

(6) Due to the vulnerability of airplanes when flying at low altitudes within the front lines and the difficulty of maintaining an effective screen at the proper time and place, the

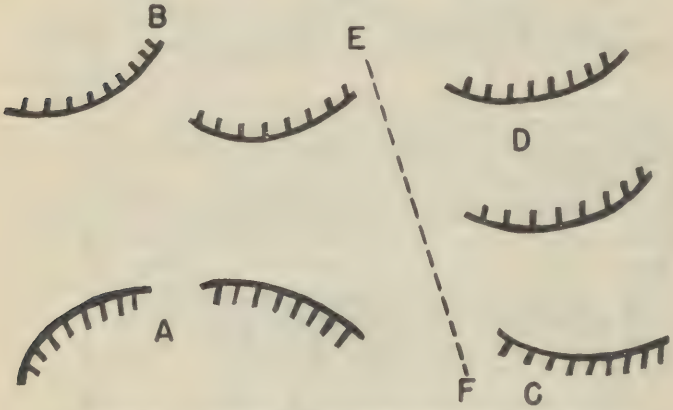


FIGURE 7.—Smoke to protect a unit from enfilade fire.

Force A has penetrated the hostile position but is held by force B.
Force C has been held up by force D.
The reserve of force D is enfilading force A.
Smoke is placed on the line E–F to protect the flank of force A.
Should the wind direction carry the smoke toward force A, the density should be low.
Should the wind direction be such that the smoke would drift on force C, high explosive or reserve action, and not smoke, should be used.

use of smoke by airplanes in the offensive is limited. Airplanes may be employed to lay a blanket of smoke over large areas to permit bombers to reach their objectives without being subjected to aimed antiaircraft fire. Smoke may also be used to screen the movement of fast moving vehicles.

(7) Smoke is employed to deceive the enemy as to the location of the main attack. For this purpose one or more screens are placed at points well separated from the main attack.

e. Incendiaries.—(1) In offensive situations incendiary agents of the scatter type are useful against personnel or in neutralizing strong points situated in combustible cover (fig. 8).

(2) In tactical situations where forward movement of friendly troops is contemplated, care must be taken when employing incendiaries that general conflagrations which might interfere with the plan of operations do not occur.

(3) White phosphorus shell of mortar and artillery weapons is a suitable munition for the purposes indicated above and has the additional advantage of obscuring observation from the hostile position. Thermite-filled shell may be used for this purpose when smoke is undesirable.

■ 19. CHEMICAL AGENTS IN THE DEFENSIVE.—*a. Nonpersistent casualty agents.*—(1) Due to the freedom of movement possessed by an attacking force, nonpersistent agents are not so freely employed in defensive action as in the offensive. While a defender is to some extent definitely tied to his position, the attacker has freedom of movement, and targets presented by him may be gone before fire can be planned and executed. This situation may be partially overcome by preparing emplacements in advance to cover areas likely to be occupied by the enemy in his attack.

(2) Nonpersistent gas attacks can, however, be effectively used to impede and sometimes break up an enemy attack. For this purpose they will be most effective when fired on his assembly areas just before the hostile forces move to attack positions.

(3) If the enemy's initial attack is not successful, he may remain in position for some time reorganizing his forces for subsequent attacks. In such cases nonpersistent gas can be effectively used on all heavily occupied areas.

b. Persistent casualty agents.—(1) *Passive defense.*—Passive defense offers the greatest opportunities for the employment of the highly persistent chemicals. In this type

FIGURE 8.—Incendiary targets.

of combat the defender has no desire to occupy the area contaminated; hence, the persistent agents can be freely used.

(2) *Land mines.*—Prior to the time the enemy arrives at our position, land mines are employed in connection with demolitions on routes of approach. They are also installed on suitable areas in rear of our outposts and fired when these are driven in to the main line of resistance.

(3) *Attacks by aircraft.*—Distant attacks may be made by aircraft directly against enemy troops and supply columns approaching our position. They may also be made on roads and defiles beyond artillery range that must be used by the enemy in his approach.

(4) *Attacks on concentrations.*—After the enemy has established close contact with our lines, attacks with persistent gas shell are made on heavily occupied areas, particularly wooded assembly areas, and on avenues of approach.

(5) *Barriers.*—(*a*) *Employment.*—Persistent agents may be employed effectively in combination with rigid obstacles and with demolitions (see FM 100–5). Their value lies in their ability to contaminate areas or strips so they cannot be crossed without coming in contact with the agent; to contaminate demolitions so they cannot be occupied or repaired without coming in contact with the agent; and to contaminate rigid obstacles so they cannot be removed without coming in contact with the agent.

(*b*) *Limitations.*—Chemical barriers are employed for two purposes only: to delay the enemy while he decontaminates them or to inflict casualties if he proceeds without decontaminating them. However, it must be realized that the enemy cannot be prevented from choosing to accept casualties and proceed without delay; therefore, chemical barriers will not *deny* an area to the enemy nor *prevent* him from crossing a barrier or removing an obstacle.

(*c*) *Tactical use.*—Chemical barriers are used—

1. *To strengthen defensive positions* (fig. 9).—Chemical barriers are placed in front of those parts of the defensive position where observation and field of fire are not good and, therefore, constitute areas favorable for enemy attack. Their purpose is to hamper a hostile penetration by strengthening the weak points.

2. *To hamper enemy's approach.*—Chemical obstacles or barriers are placed upon hostile avenues of approach such as roads, trails, stream crossings,

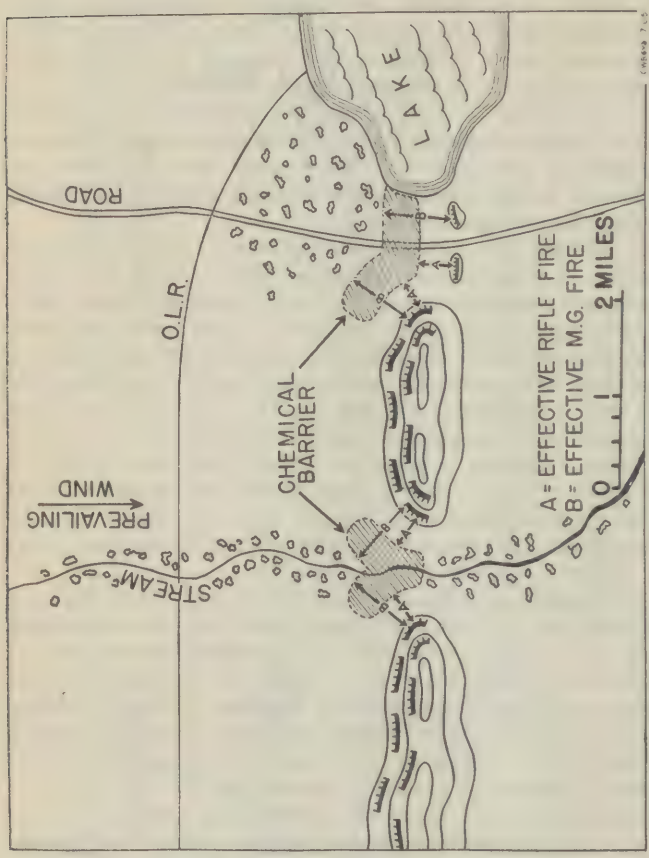


FIGURE 9.—Chemical barriers used to strengthen weak points in defensive position.

natural cover, ravines, bridges, mountain passes etc., in order to delay the enemy's advance.

3. *To strengthen obstacles.*—Terrain features which are natural obstacles and man-made barriers which are set up in front of a position can be contami-

nated to good effect to hinder their removal and increase the vulnerability of troops which must overcome them.

4. *To increase effectiveness of demolitions.*—Structures and matériel which can be only partly destroyed will have their usefulness materially decreased by contamination. Restoration of demolitions is rendered more hazardous by contamination. In the demolition of bridges it is advantageous to contaminate not only approaches but adjacent terrain points which are favorable locations for constructing a new bridge or for fording.

(*d*) *Size.*—The extent of the area to be contaminated depends upon the time and matériel available. Generally, however, no contaminated area can be considered an effective casualty producing barrier unless it is at least 100 yards in depth. However, its depth should not ordinarily exceed the range limits of effective machine-gun fire. (See fig. 9.) The width depends upon terrain features and the tactical situation. In defensive situations the entire width of the critical area should be covered. In delaying actions or retirements, the width need not be greater than the hostile avenues of approach, such as roads, trails, ravines, etc. Terrain features which are vital may be advantageously contaminated regardless of size. Low ground, clumps of brush, and small wooded areas where the enemy would normally seek cover can be contaminated to good advantage even when they extend over only a small area. When personnel and matériel are limited, chemical barriers should be confined to the more vital parts of the critical areas rather than attempting to cover the entire area.

(*e*) *Distance from front.*—Hostile forces should be under effective small-arms fire when crossing chemical barriers. Therefore, barriers should be placed as close to our own front as is consistent with safety to our own troops. Safety limits depend upon whether *prevailing* winds are favorable or unfavorable. A distance of 600 yards is considered as the minimum when the wind direction is unfavorable and 400 yards the minimum in a favorable wind. However, complete safety to our own troops should not be the determining factor if a good tactical advantage can be obtained. It may be

of tactical advantage to subject our troops to the vapor of mustard gas thus forcing them to wear gas masks for limited periods.

c. Harassing agents.—Irritant gases of the nonpersistent type are employed in defense against the same types of targets as the nonpersistent casualty agents and the persistent irritant gases against the same types of targets as the persistent casualty agents.

d. Smoke.—(1) Observed fire of a defending force is more efficient than that of an attacking force. Smoke should not be placed upon the forward elements of the attacking foot troops by the defender because it would nullify this advantage by preventing aimed fire and deny the defending force vital information of the actions of the foot troops. However, a blanket of smoke placed on the leading elements of attacking tanks as they approach the effective range of antitank guns will cause them to slow up, lose direction, and become disorganized. Furthermore, as the tanks come out of the smoke cloud toward the antitank guns, they become excellent targets to be taken in turn by these weapons.

(2) Use of smoke in the defense is therefore limited to the screening of artillery observation posts in rear areas, to the counterattack in the same manner as in the offense, to blanketing approaching tanks beyond the range of antitank weapons, and to cover withdrawals.

e. Incendiaries.—(1) When wind direction and the condition of vegetation are favorable, grass, brush, or forest fires may be set to interfere with the progress of the hostile attack.

(2) In selecting target areas for incendiary operations of this nature, consideration should be given to the probability of the fire spreading to our own positions.

■ 20. CHEMICAL AGENTS IN STABILIZED OPERATIONS.—*a. Nonpersistent casualty agents.*—Where the opposing lines are fairly close, chemical cylinders filled with nonpersistent gas may be installed over wide fronts and, when weather conditions are favorable, released against large elements of the enemy force. Shell attacks are made on areas occupied by enemy troops to precede an attack by our forces, to forestall an attack, or to weaken his forces.

b. Persistent casualty agents.—Persistent casualty agents are employed in shell, airplane spray, or bomb attack against personnel, to deny or force evacuation of important positions, roads, and defiles, and for counterbattery. In withdrawals from advanced positions, land mines are employed to contaminate positions the enemy may occupy, and to contaminate obstacles, thereby increasing their value.

c. Harassing agents.—Irritant gases are employed to harass opposing forces for long periods.

d. Smoke.—Smoke is used to screen a local attack, counterattack, or raid, to deny observation for the control of enemy fire, and to cover a withdrawal.

■ 21. CHEMICAL AGENTS IN RETROGRADE MOVEMENTS.—*a. Smoke and irritants.*—In withdrawals or retirements smoke is employed to deny observation of our movements and to reduce the efficiency of hostile fire. Irritant agents are used with smoke to force the enemy to mask and thus hamper his pursuit.

b. Persistent agents.—Persistent casualty agents are effectively used on bridges, defiles, and roads to delay pursuit, and produce casualties in the enemy forces. Chemical land mines filled with these agents may be used in conjunction with demolitions and obstacles to hamper the enemy advance.

c. Incendiaries.—(1) Incendiaries may be freely used to set general fires to interfere with and delay the progress of the enemy's advance.

(2) Incendiary grenades are useful to destroy supplies and matériel which must be abandoned, and to ignite houses and other structures which may afford shelter to the enemy.

(3) Incendiary and persistent gas operations should be coordinated so that fires do not neutralize gas contaminations.

■ 22. CHEMICAL AGENTS IN SPECIAL OPERATIONS.—*a. General.*—Employment of chemicals in special operations follows in principle the methods outlined for their use in the offensive and defensive.

b. Smoke in river crossings.—Because of the danger of these operations in daylight, they are conducted normally at night. Night crossings, however, are difficult of execution. Smoke can be used to assist a crossing made during daylight hours,

thereby nullifying many of the disadvantages of night crossings.

(1) *Concealment of crossing location.*—A situation is rarely encountered where a crossing can be made at only one point. Covering a number of possible crossing points with smoke may deceive the enemy as to the point or points at which the crossing is actually being made. The smoke should be placed on the defender's side of the river by means of chemical mortars or artillery. Such operations should be carried out on broad fronts and for a considerable period of time.

(2) *Covering engineer operations.*—Engineer troops engaged in launching assault boats or constructing bridges during daylight hours will often be subjected to well-aimed enemy fire. The effect of this fire will be greatly reduced, and may even be nullified by the use of smoke. When used for this purpose smoke is placed upon the hostile position, and the cloud established before engineer forces are exposed to view. Failure to observe this latter point will permit the enemy to lay machine guns on the point of operations and fire effectively through the smoke.

(3) *Cover for leading elements of crossing force.*—Advance infantry elements of a crossing force are seriously handicapped because of exposure to aimed small-arms fire and their inability to return this fire. Smoke used to cover engineer forces should be continued during the crossing of these leading infantry elements and also during the time required by them to advance and form for the assault. Firing should cease at such time as will permit the cloud to dissipate before the assault is launched.

(4) *Cover for supporting elements.*—After the leading infantry elements have established a bridgehead, the supporting troops must cross. With the hostile infantry driven back by the leading elements, the supporting elements are not exposed to the fire of infantry weapons. They are, however, exposed to artillery fire. To be effective this fire must be controlled either from terrestrial OP's or by airplane observation. To prevent this control, the defender's terrestrial OP's may be blinded by smoke fired by mortars or artillery, and airplane observation may be denied by covering the area with a blanket of smoke. This blanket may be placed by

airplanes. It should not be so dense that crossing forces will lose their direction.

(5) *Night crossings.*—Smoke is normally employed during the daylight hours. However, movement on water can often be observed at night, particularly if the night is clear. The crossing force in this case becomes a well outlined target, and hostile fire will be highly effective. Smoke can be employed to cover the crossing force at night as well as by daylight. The firing in night operations should be delayed until it is certain the enemy has knowledge of the crossing. Weapons for firing the smoke shell, however, should be laid on the target and ready to open fire on signal from the crossing force that smoke is needed.

c. Landing on hostile shores.—A landing on hostile shores has many of the characteristics of a river crossing. Smoke will be found of value in covering the approach of small boats and the debarking of troops. The initial screen to cover the approach can best be placed by aircraft laying the smoke well off shore and repeating the operation as often as necessary. The final stages can best be covered by smoke fired from ships or bombs dropped by airplanes.

CHAPTER 2

USE OF CHEMICAL AGENTS BY VARIOUS TROOPS

SECTION I

CHEMICAL TROOPS

■ 23. ORGANIZATION.—Chemical troops (weapons) are organized and equipped for the purpose of firing chemical agents. Their organization is such that they may be employed as regiments, battalions, companies, or platoons, with the smaller elements either removed from the control of the larger units or operating directly under them. The size and control of the elements of chemical troops employed in any situation are determined by the mission and the number and type of weapons to be used.

a. Chemical motorized battalion, separate.—The battalion is the basic combat chemical unit. Its organization includes a headquarters, headquarters company, and four weapons companies. An ammunition train is included in the headquarters company. The chemical fire power is 48 chemical mortars. Other chemical weapons and munitions used by chemical troops are the land mine, livens projector, portable chemical cylinder, and irritant candle. (See T/O 3–25 and appendix X for details of the organization of this unit.)

b. Headquarters company.—The headquarters company consists of company headquarters for internal administration and supply, a staff section consisting of the enlisted personnel required by the battalion commander and staff, and a communication section for communication between the battalion and the unit to which attached and with the companies, a battalion motor maintenance section and an ammunition train consisting of train headquarters and four

ammunition sections. (See T/O 3–26 for details of organization.)

c. Chemical weapons company mortorized. — This unit consists of the company headquarters and two platoons. The company is organized and equipped to act independently of battalion control when required. When a company is detached from its battalion and attached to a task force, an ammunition section from the battalion headquarters company is attached to the weapons company. The fire power of the chemical company is 12 mortars. As indicated in *a* above, the company is prepared to employ other chemical weapons and munitions. Personnel and weapons are transported by organic trucks in strategic movements. In tactical operations, weapons and ammunition are carried on handcarts or by hand carry. (See T O 3–17 for details of organization.)

■ 24. CHEMICAL ARMAMENT.—The military characteristics of the weapons and munitions listed below are shown in appendixes IV, V, and VI. The techniques of these weapons and munitions are described in FM 3–20. For description and function of this matériel see the Technical Regulation or Technical Manual reference under each weapon.

a. 4.2-inch chemical mortar (fig. 10).—This mortar is the principal weapon of chemical troops. It is applicable to all types of warfare. Mortar shell fillings include nonpersistent casualty agents, persistent vesicants, irritant gases, and smoke. (See TR 1120–75.)

b. Chemical land mine.—The land mine consists of a thin-walled container of 1 gallon capacity filled with a persistent vesicant agent. Mines are emplaced by hand and the contents dispersed by the action of the bursting charge detonated by either electric means or a time fuze. (See TM 3–300.)

c. Livens projector (fig. 11).—This is a large caliber (8-inch) chemical weapon. It is fired only once from an emplacement and projects a shell containing approximately 28 pounds of nonpersistent casualty agent. Livens projectors are employed in large numbers and fired simultaneously by electricity.

d. Portable chemical cylinder (fig. 12).—This is a steel container which holds approximately 35 pounds of nonpersistent casualty agent under pressure. The agent is dis-

FIGURE 10.—4.2-inch mortar operated by chemical troops.

FIGURE 11.—Livens projector battery.

charged through an eduction tube, valve, and nozzle. A large number of cylinders may be discharged simultaneously by electricity or singly by hand. (See TM 3–315.)

FIGURE 12.—Portable chemical cylinder.

c. Irritant candles.—These munitions are an effective means of producing an irritant smoke cloud. They may be ignited manually or electrically. (See TM 3–300.)

■ 25. ASSIGNMENT AND CONTROL.—The tactical mission of chemical troops in war is to assist the field forces by means of chemical operations. In carrying out this mission chemical troops fill a combat need which either cannot be met at all, or which cannot be fully satisfied by other troops with means which are organically a part of their arm.

a. Assignment.—Combat chemical troops are assigned to GHQ reserve. This arrangement gives the commander of the theater of operations the maximum flexibility in the employment of chemical troops. He may assign the entire force or any part of it to an important sector, or by means of attachment he can make these troops available to army commanders in such quantities as may in his opinion best meet the requirements of the tactical situation. In a similar manner army commanders may attach the chemical troops made available to them in corps in such quantities as the situation may require. Corps commanders may likewise attach them to divisions, and the divisions to their subordinate elements.

b. Control.—The control of chemical troops in combat varies widely with the type of operation, with the chemical agent being used, and with the type of weapon with which these troops are armed. In mobile warfare chemical troops are normally employed in battalion or similar units under division control. In stabilized warfare they may frequently be employed in large units under corps, army, or higher control. For nonpersistent gas operations they are most effectively employed in battalion or larger units under division or higher control. For persistent gas operations they may be employed in large units under corps or army control or in relatively small units under division control. When used in small units, they may be attached to lower echelons and restrictions placed on the extent and location of targets by higher commands. For smoke operations, they are employed by platoons under infantry regiment, or battalion control. For livens projector or cylinder operations, chemical troops usually are employed in large numbers under the control of corps or higher units. For mortar operations they may be employed either in small or large units.

■ 26. CHARACTERISTICS AND POWERS.—The combination of large numbers of chemical munitions with flexibility of organization makes chemical troops the most effective troops in chemical action against objectives within their range. The characteristics and powers of chemical troops in various types of operations are as indicated below.

a. Nonpersistent casualty agents.—As a general rule, the chemical battalion is the smallest unit that should be employed in nonpersistent gas attacks for casualty effect. However, small heavily occupied areas especially when low and wooded may be effectively engaged by a chemical company.

(1) *Chemical mortar operations.*—A chemical battalion, using its 48 mortars, can effectively attack an area of 32 squares (100 by 100 yards each) when 30 rounds of phosgene-filled shell per mortar are available. The cloud is effective over a similar area in its down wind travel. About half an average infantry battalion defense area, therefore, would be included in such an attack. When the situation does not permit bringing up additional ammunition for this type of operation, the battalion can attack a smaller target such as an infantry company defense area.

(2) *Livens projector operations.*—A battalion projector operation, firing 800 livens projectors on an impact area of 53 squares, is effective over an average infantry battalion defense area. Livens projectors are not organic weapons of chemical troops, but must be brought forward from a chemical depot. The short range of these weapons requires their emplacement close to advanced positions. When the transportation and emplacement of the matériel must be accomplished entirely under cover of darkness, at least one night is required to prepare for such an attack.

(3) *Portable chemical cylinder operations.*—The capabilities of the battalion in cylinder operations are dependent upon the hours of darkness available and the missions to be undertaken subsequent to the cylinder attack. One chemical battalion can install about 2,300 in one night. These can adequately cover a target of 2,300 yards' frontage at 1,000 yards' range under average conditions. (See app. VII.) When subsequent mortar operations are to be engaged in, the chemical battalion can install about 850 cylinders.

b. Persistent casualty agents.—The strength of chemical troops required to project persistent agents for neutralization of terrain features, for creation of chemical obstacles and barriers, or for direct action against personnel is dependent upon the magnitude of the operation and the time available for its execution.

(1) *Chemical mortar operations.*—The creation of chemical barriers requires large quantities of ammunition. A chemical company, using its 12 mortars, can contaminate about 75 squares in 1 hour. This degree of contamination will be approximately the same as that attained with 20 chemical land mines per square. For the purpose of comparison, a battalion of 105-mm howitzers can similarly contaminate about 21 squares per hour.

(2) *Chemical land mines.*—One chemical company can emplace the necessary land mines to contaminate an area of 100 squares in approximately 4 hours. The mines may be discharged on completion of the mine field or at a time subsequent to its completion. A delay in firing requires frequent checks on the firing system to assure that it will function when required. When these mines are used for road contamination, one squad can contaminate 1 mile of road per hour.

c. Smoke operations.—The chemical mortar is the principal smoke weapon of chemical troops and the platoon is the fire unit. Using three of its six mortars, a chemical platoon can screen about 600 yards of front, assuming the most unfavorable wind direction.

■ 27. IN THE OFFENSIVE.—The mission of chemical troops during offensive operations is to assist the attacking troops in gaining their objective. In carrying out this mission chemical troops engage in operations in preparation for the attack and in operations in support of the attack. This assistance is provided by the use of gas or smoke.

a. Nonpersistent agents.—(1) In a mobile offensive the principal agents for general use immediately preceding or during an attack are the nonpersistent gases. The principal chemical warfare weapon for projecting these agents within its range is the 4.2-inch chemical mortar.

(2) In preparation for the attack chemical troops fire nonpersistent chemical agents for neutralization or for harassing effects. For neutralization, nonpersistent agents are fired on defense areas or on supporting elements within range. Attacks are so timed as to secure the maximum surprise effects. For harassing, nonpersistent irritant agents are fired intermittently on large sections of the enemy positions.

(3) Supporting operations, both for the purpose of neutralization and for harassing effect, will consist of gas attacks planned in advance and fired during the first stages of the attack, and those that may be required as the action progresses. Nonpersistent gas fired in the first phase will normally be fired on areas occupied by units the size of a battalion or larger. In the second phase, opportunities for the use of the nonpersistent agents will be considerably less frequent and suitable targets smaller. They should normally be areas occupied by opposing companies or battalions. However, the importance of certain positions or the resistance of certain elements may justify the fire of chemical troops on smaller targets. The harassing agents may be employed in supporting operations in lieu of the casualty agents for economy reasons, and targets therefore will be similar to those for the casualty agents.

(4) Portable chemical cylinders and livens projectors may be employed by chemical troops in the offensive in preparation for and in the initial phase of an attack, provided sufficient time is available prior thereto for the installation of these weapons. The time required to bring these weapons to the place of installation and to install them will usually be a minimum of 12 hours.

b. Persistent agents.—(1) In the offensive the employment of the persistent casualty agents by chemical troops is limited to targets that can be easily identified and avoided in the advance by the attacking troops. Suitable targets are positions on the flank of the zone of attack and prominent positions within the zone of attack so strongly held that their capture by direct assault will result in excessive casualties to the attacking force.

(2) Persistent gas attacks may be fired either in the preparation period or during the initial phase of the attack. They should ordinarily not be fired sufficiently in advance

of the attack to permit the enemy to change his dispositions to meet our probable method of attack, nor on the other hand should they ordinarily be fired so late that casualties will not occur in the enemy forces during the progress of the attack.

(3) Persistent irritant agents may be fired by chemical troops on any target that our troops are not expected to occupy during the effective period. Since most of these agents are not effective for more than an hour, they may be used in preparation for the attack. During the initial phases and during the progress of the attack they will be fired principally on targets that can be avoided by our own troops.

(4) The only weapon available to chemical troops for projecting persistent agents in the offensive is the 4.2-inch chemical mortar. Due to the limited range of this weapon the firing of the persistent agents by chemical troops will usually be supplementary to that of the field artillery.

c. Smoke.—(1) Beginning with H-hour the chemical agent of most general value is smoke. During this phase, chemical troops using chemical mortars are employed to fire large scale smoke screens to cover the advance of infantry battalions. Smoke is normally fired on the hostile elements most likely to hamper the advance of our own forces. The first choice should be those positions strongly organized with defensive fires and having fields of fire most difficult for our forces to cross.

(2) These missions usually come in planned operations in which the time and place of establishing the screen and the length of time it is to be maintained are carefully coordinated with the infantry plan of attack. The firing should begin about 2 minutes prior to the time the infantry unit crosses the line of departure or comes under effective small-arms fire, and should be placed on the forward elements of the enemy position so that the casualty value of white phosphorus may also be obtained. It should be continued until the advancing troops, masked by the fire of the smoke weapon, reach the assaulting distance, about 300 yards from the enemy positions.

(3) During the first phase of the attack and also as the attack progresses, small organized positions containing in-

fantry weapons seriously interfering with the advance of small units may be located. Smoke is normally placed on these by infantry mortars. If these mortars are not available due to other missions, these small targets should be screened by chemical mortar units.

(4) As the attack progresses there may also be large organized positions in the enemy's main line of resistance, or in his secondary positions that are holding up the advance, or one unit may advance to a position where large hostile elements on the flank can bring enfilade fire on another unit. These larger types of targets should be engaged by chemical troops firing white phosphorus both for casualty and for screening effects.

d. Control.—(1) In making attachments of chemical units or in the assignment of chemical missions to chemical troops, priority should be given to the main attack. However, for purposes of deception or when the terrain favors the use of chemicals in the zone of the holding attack, it may be desirable to employ all, or a large part, of the attached chemical troops in that zone.

(2) For missions to be conducted prior to H-hour, usually chemical troops are retained under centralized control. This is particularly desirable for livens projector and cylinder operations which are usually conducted by a chemical battalion or larger chemical unit.

(3) For smoke missions to be conducted at H-hour, or subsequent thereto, chemical troops usually can be more effectively employed by the attachment of platoons to attacking battalions. When the platoons of a chemical company attached to an infantry regiment are attached to attacking battalions, the company headquarters is held under regimental control for the supply of chemical ammunition to its platoons. In this case the company commander acts in the capacity of chemical advisor to the infantry regiment commander.

■ 28. IN THE DEFENSIVE.—The mission of chemical troops in the defensive is to assist the infantry in delaying and breaking up the hostile attack, and should such attack succeed in penetrating the defense, to assist in the counterattack.

a. Nonpersistent agents.—(1) Chemical troops using the chemical mortar are employed in the defensive to fire non-

persistent agents on targets of opportunity, such as troops forming for the attack, or on supports and reserves. In special situations, as in the defense of a city or an important installation where suitable forming-up areas and directions of attack are limited, livens projectors may be installed in advance and fired on such areas when they become occupied. If wind directions are favorable, portable chemical cylinders may be employed in such situations.

(2) In situations where the enemy remains in position in close contact for some time, chemical troops using chemical mortars or livens projectors and cylinders should be employed to fire nonpersistent gas concentrations on all areas within range known to be heavily occupied by the enemy.

b. Persistent agents.—(1) Prior to contact with the enemy, chemical troops employ chemical land mines to place chemical barriers of persistent vesicants in front of their own infantry position, and by the same methods interdict routes of approach and neutralize areas of importance to the enemy in his advance.

(2) After the enemy has begun his attack the only weapon available to chemical troops for interdiction or neutralization missions is the chemical mortar, except in retrograde movements where as a rule chemical mines may be used. Suitable targets for chemical mortar fire are areas that are or may be used by the enemy for the installation of weapons from which to fire on our positions. Such areas may be woods and valleys being used or that are likely to be used by the enemy in forming for the attack, and routes of approach, both front and flank, that may be used by the enemy in his advance.

(3) Persistent irritant gases may be used on similar targets to harass the enemy and to hinder his operations.

c. Smoke.—The employment of smoke by chemical troops in the defensive is in general limited to the screening of counterattacks. It may also be used in withdrawals. Smoke in such situations should be fired on or close in front of the enemy leading elements in order to deceive him, if possible, and to reduce the effectiveness of his fire. Smoke should be employed against hostile armored attack in conformity with the doctrine stated in paragraph 19*d*.

d. Control.—(1) The control of chemical troops in defense depends primarily upon the location of suitable targets.

(2) In the contamination of demolitions with persistent gas mines, small detachments usually are attached to the engineers. Extensive land mine operations, especially those involving only one part of the sector of a large command, usually are conducted under the control of the higher commander.

(3) For persistent gas missions fired with chemical mortars, chemical companies usually are attached to infantry regiments if suitable targets exist within regiment sectors. If suitable targets do not exist in regiment sectors, chemical mortar units are held under higher control.

(4) If practicable, nonpersistent gas missions are fired by chemical battalions operating under division or higher unit control.

(5) For the firing of smoke to support a counterattack, a platoon of chemical troops usually is attached or placed in support of the attacking battalion.

■ 29. In Stabilized Situations.—The mission of chemical troops in stabilized situations is similar to that of other supporting arms, that is, they carry on an operation of attrition until such time as the offensive may be taken.

a. Nonpersistent agents.—(1) The projection of nonpersistent gas by chemical troops in stabilized situations may be accomplished with the chemical mortar, the chemical cylinder, or the livens projectors, and at times even by all three.

(2) Suitable targets for mortar operations will be strongly held defense areas within range. Chemical attacks against these may be made from time to time as weather conditions permit, to wear down enemy resistance gradually. They may precede an attack or raid by our own forces with the object of weakening immediate opposition. Also, they may be made at the proper time to forestall an enemy attack. Livens projectors may be employed to fire upon hostile troop concentrations. Livens projector attacks may be employed in conjunction with chemical mortars, the former fired upon large areas close to our own lines and the latter upon suitable targets beyond the range of the livens projector.

(3) With favorable weather conditions, portable chemical cylinders are used by chemical troops on wide fronts. They

are most effectively employed against heavily occupied sectors of enemy positions within close range. They may be employed from time to time to weaken the enemy as a whole, or before an attack to reduce the immediate opposition.

(4) The irritant candle is used in a manner similar to the cylinder for the purpose of harassing and causing temporary casualties in enemy forces.

b. Persistent agents.—(1) Persistent gas of the vesicant type may be used by chemical troops in stabilized warfare against enemy personnel for direct casualty effect, and to deny important positions, roads, and lines of communication. The only weapon available for firing persistent gas in these missions is the chemical mortar. Suitable targets are strongly organized enemy positions, particularly those from which effective fire is being delivered upon our own troops, wooded areas known to be heavily occupied, and routes of communication within enemy lines. In local attacks or raids, vesicant agents may be fired at targets on the flanks in order to protect troops against enfilade fire.

(2) Persistent irritant gases are fired by chemical mortars intermittently for harassing purposes, or they may be fired upon the enemy during his attack to hinder and weaken his effort.

c. Smoke.—Chemical troops may employ smoke in stabilized situations to screen movements within our own lines and to support local attacks, counterattacks, or raids in much the same manner as in the offensive. White phosphorus may effectively be employed for casualty effect alone against machine-gun nests and other strongly organized positions.

d. Control.—In stabilized operations, chemical troops are employed in large numbers under large unit control for nonpersistent gas missions. For persistent gas missions, chemical troops are employed either in large or small units depending upon the location of suitable targets. At least one platoon of chemical troops should be available to each infantry regiment for smoke support in local counterattacks.

■ 30. In Special Situations.—*a.* The employment of chemical troops in special operations conforms in general to that of the offensive or defensive.

b. Land mines are effectively employed in withdrawals to contaminate roads and defiles, and to create barriers of

vesicant agents across the enemy advance. They may in like manner be employed in the defense of a shore line to contaminate beaches likely to be used by the enemy for landing purposes.

■ 31. IN CAVALRY OPERATIONS.—*a.* In offensive operations of cavalry, success depends upon rapid, aggressive action. Due to the limited time involved and the rapidly changing situations, the employment of chemical troops is largely limited to the use of the chemical mortar in smoke operations.

b. Cavalry in mounted action is very vulnerable to the fire of automatic weapons. Chemical troops should be employed in this action to lay smoke upon the opposing lines in an effort to reduce the effect of this fire, and to cause casualties. Smoke may also be fired to enable the maneuvering force to reach a suitable position from which to launch the attack without being observed and without being subjected to aimed fire.

c. In defensive operations the use of smoke is limited to the screening of enemy observation. Irritant gases may be fired effectively upon opposing cavalry to force masking of personnel and horses. In delaying actions, chemical troops using chemical mortars and land mines may effectively be employed to contaminate roads and defiles and to create barriers of vesicant agents. The general principles applicable to horse cavalry apply equally well to mechanized cavalry.

d. In dismounted action chemical troops may be employed with cavalry in all types of chemical attacks in much the same manner as prescribed for operations with infantry.

SECTION II

INFANTRY

■ 32. ORGANIZATION.—Infantry armament for firing chemicals is limited to grenades and mortars. For large scale chemical operations, infantry must call upon troops of other arms for support. The troops equipped to provide special support with chemical agents are those of the Chemical Warfare Service, Army Air Forces, Field Artillery, and Corps of Engineers.

■ 33. CHEMICAL MATÉRIEL.—*a 81-mm mortar.*—The 81-mm mortar platoon of the heavy weapons company of the infan-

try battalion is employed to fire smoke screens of limited extent and duration. Under average conditions it requires about one and one-half rounds of smoke shell per minute per 100 yards to maintain an effective screen, with three times this amount fired during the first minute. Therefore, with ammunition loads normally accompanying a platoon, it can establish and maintain under average conditions a smoke screen across a front of 300 yards for a period of 8 minutes. If the operation can be planned sufficiently far in advance to permit the supply of additional smoke shell from the combat train, it can establish and maintain screens of correspondingly greater extent and duration. Except under very favorable conditions a screen of greater frontage than 600 yards should not be attempted.

b. Chemical grenades.—(1) *Smoke and gas.*
Smoke (WP).
Irritant gas (CN–DM) (FM 23–30, TM 9–1900).
(2) *Antitank.*
Smoke.
Incendiary (scatter type).
Casualty and irritant gas.
(3) *Incendiary.*
Thermite (TH) (intensive incendiary).
White phosphorus (WP) (scatter incendiary).

■ 34. SELECTION OF OBJECTIVE.—Since the number of weapons and amount of ammunition that the infantry can assign for the projection of chemicals is limited, special care should be exercised to insure that they are confined to a few objectives in order that their effect will be in accord with the principle of mass. If sufficient weapons are not available to cover the local front with chemicals, the stronger or more vital sector should be selected as the objective and the weapons concentrated thereupon. The effectiveness of all chemical agents is dependent upon attaining an adequate concentration. The advantage of covering wider territory is always subordinate to the building up of a sufficient concentration within a given area. Mortar platoons should function ordinarily as a unit, and individual weapons rarely be given separate objectives.

■ 35. AGENTS SUITABLE FOR INFANTRY SUPPORT.—All chemical agents are suitable to support infantry operations and, with

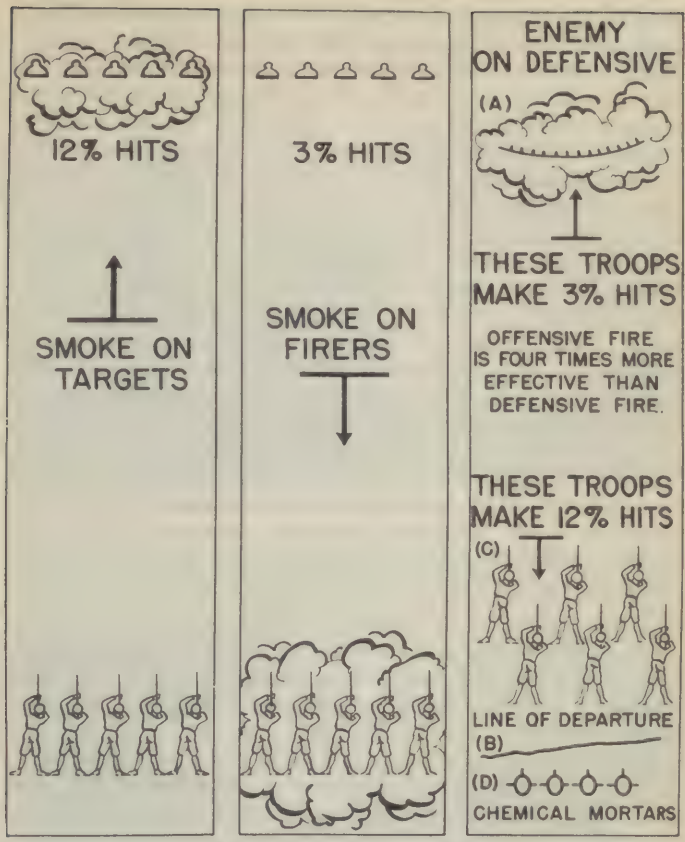
the exception of casualty agents, can be used by infantry troops in local situations without calling upon the services of supporting arms. Casualty agents must be projected by chemical troops, artillery, or elements of the air force. Support of one or more of these supporting arms is also required in all large-scale chemical operations.

a. Smoke.—This agent can be employed to great advantage by the infantry. Its principal use is to neutralize hostile fire and to blind hostile observation. By the proper use of smoke, nighttime conditions are imposed upon hostile elements while friendly troops retain daytime maneuverability. The basic consideration in the use of smoke is that it must accomplish its mission without unduly impeding the action of friendly troops or seriously interfering with the elements of command. When employed, smoke should be placed immediately in front of and directly upon the enemy force that is to be neutralized. Those projectiles which fall directly among the enemy troops will cause casualties, confusion, and disorganization. In the absence of good natural cover along the entire front of the enemy position, it is desirable that screens be laid beyond the actual flanks so that hostile forces are prevented from observing the terrain from those directions. By placing smoke upon an enemy firing line, our troops are given a fire superiority of about four to one. (See fig. 13.)

b. Nonpersistent harassing agents.—Because they act immediately, nonpersistent harassing agents are especially useful in infantry local operations inasmuch as they surprise the enemy and permit an immediate tactical advantage with economy of force thus providing a fire superiority in fact without superiority in numbers. Although not casualty producing, irritant agents force immediate masking, and their harassing effect upon any enemy force creates an immediate tactical advantage. In the use of irritant grenades for such local operations, consideration should be given to wind direction.

c. Persistent agents.—Infantry munitions do not include fillings of persistent agents. When the infantry desires their employment, supporting troops must be utilized.

d. Incendiaries.—The infantry will find incendiary agents excellent for driving hostile forces from small woods, fields



A. Enemy line.
B. Our line.
C. Our troops.
D. Our smoke firing line.

FIGURE 13.—Theory of blanketing smoke.

of dry grass and crops, brush, and wooden structures. Generally, scatter type incendiary hand grenades may be used against personnel and dry vegetation, while thermite grenades may be used against buildings. Intensive incendiary grenades are useful against tanks and other armored vehicles.

■ 36. IN OFFENSIVE SITUATIONS.—*a. Initial assault.*—Where good cover is not afforded the attacker by the terrain, smoke should be placed upon the forward elements of the defensive position when the attack formation comes under effective small-arms fire and until the assault stage is reached. Smoke firing should be terminated soon enough so that the assault can be executed without smoke hindrance.

b. Combat through depth of position.—In this phase of infantry attack, which becomes a series of local encounters involving small units, chemical grenades are of particular value. Irritant grenades alone, or in conjunction with smoke will help prepare for the assault on local defense areas. Scatter type incendiary grenades are especially useful in capturing hostile automatic weapons positions. Smoke firing from infantry mortars may be employed to protect the flanks of advancing units from enfilade fire (par. 18*d*(4)).

c. Occupation of captured position.—Although useful in reducing effectiveness of hostile small-arms and artillery fire, smoke fires should be so limited that observation of the battlefield is not materially affected. The screens required for this purpose should preferably be fired by support artillery and directed against possible observation posts.

■ 37. IN DEFENSIVE SITUATIONS.—While persistent casualty agents can be used to advantage in creating chemical barriers and in contaminating rigid obstacles, the use of such agents for this purpose is the function of artillery, chemical troops, engineers, and the air force.

a. Antitank defense.—Smoke fires placed upon leading elements of advancing tanks will serve to delay and disorganize the attack. Infantry mortars can be used advantageously to supplement the fire of chemical troops. In a close antitank defense, gas and incendiary grenades are useful against individual armored vehicles.

b. Withdrawal from action.—Smoke is used to cover a daylight withdrawal. Full use should be made of the 81-mm mortar for the projection of smoke.

■ 38. SPECIAL SITUATIONS.—*a. Combat in woods.*—Incendiaries may be used to drive hostile forces from wooded areas under dry weather conditions, and nonpersistent toxic agents used under other circumstances. While a hostile force

within a woods has the advantage of firing upon troops from a concealed position, this advantage can be nullified by providing cover for our own troops through the use of a smoke screen.

① Cloud from single grenade a few seconds after release.

② Same cloud a few seconds later showing travel down wind.

FIGURE 14.

b. River crossings.—See paragraph 22.

c. Village fighting.—Incendiary hand grenades will start fires that will drive enemy troops from cover within buildings. Irritant agents can be used in the same manner.

SECTION III

FIELD ARTILLERY

■ 39. ARTILLERY WEAPONS AND AMMUNITION.—Chemical agents are fired by the following artillery: the 75-mm gun, 75-mm howitzer, 105-mm howitzer, 155-mm howitzer, and the 155-mm gun. The characteristics of field artillery weapons are to be found in FM 101–10 and in appendix IV.

a. Chemical fillings for 75-mm shell are the persistent agents and smoke. Upon the burst of the shell, liquid agents are thrown over an area approximately 6 yards in diameter; solid agents, 15 yards in diameter. The 75-mm gun is particularly suitable for the prolonged firing of persistent vesicants. It is used to produce uniform distribution of these agents over large areas. Due to its small shell capacity and its relatively slow rate of fire, it is not suitable for firing nonpersistent agents or extensive smoke screens.

b. The general characteristics and suitability of the 75-mm howitzer for firing gas and smoke are the same as those of the 75-mm gun.

c. The 105-mm howitzer is suitable for firing smoke and persistent agents. Upon the burst of the shell, liquid agents are thrown over an area approximately 10 yards in diameter; solid agents, 40 yards in diameter.

d. The 155-mm howitzer is suitable for firing all types of gas and smoke. Due to its slow rate of fire and the amount of ammunition required, its value for firing nonpersistent gas or smoke on extensive targets is limited. Upon the burst of shell filled with a persistent agent, the agent is thrown over an area approximately 15 yards in diameter; solid agent, 50 yards in diameter. Near the center the dispersion is very heavy. This characteristic makes the 155-mm howitzer suitable for heavy contamination of roads and small areas.

e. The 155-mm gun has the same general characteristics for firing gas and smoke as the 155-mm howitzer.

■ 40. APPLICATION OF CHEMICAL SHELL TO ARTILLERY FIRES.—*a.* The principal mission of large caliber artillery (240-mm) is fire for destruction, while that of light and medium artillery is primarily for neutralization. These weapons, however, are not confined to a single type of fire mission; the larger

calibers may at times be used for neutralization and the medium, particularly the 155-mm howitzer and the light calibers, may frequently be used for destruction.

(1) The principal chemical agent used in fire for destruction is white phosphorus, because of its incendiary action. Mustard gas has some destructive value due to its ability to render equipment, food, and water unfit for use.

(2) Neutralization fire is delivered either directly or indirectly against personnel. Nonpersistent casualty agents are employed for neutralization fire where large bodies of troops are found in small areas. Persistent vesicants are used directly against personnel for casualty effect, or to contaminate areas in order to deny them to the enemy. Smoke is used to blind enemy observation, thus making difficult the direction and control of his fire. Irritant agents are used to harass the enemy and hinder his operations.

b. Persistent vesicants are by far the most important chemical agents employed in artillery fires. The extensive firing of nonpersistent gas and smoke by the artillery is prevented by the difficulties of supplying ammunition in the quantities required and the frequent interference with other missions. The artillery's relatively slow rate of fire and small shell capacity make it impossible to put down an effective concentration on large areas during the required period of 2 minutes. This further limits the use of nonpersistent agents. On the other hand, concentrations of persistent vesicants can be built up gradually by a small number of guns firing at their prolonged rate and at times when there will be no interference with other missions. Once these concentrations have been built up, they can be maintained with a small expenditure of ammunition.

■ 41. IN THE OFFENSIVE.—*a.* During the period of preparation for the attack, nonpersistent agents are fired by the artillery on small occupied areas beyond the range of the weapons of chemical troops. The use of persistent gas in offensive operations will be limited to areas which can be readily identified by troops on the ground. It must be determined that contamination of such areas will not hamper the operations of friendly troops. Persistent vesicants are an economical and effective ammunition for use in counterbattery fire. Such

fires executed during the period of preparation force the enemy to move or suffer casualties at a time most favorable to the attack. However, the desirability of using persistent gas for this purpose must be weighed against subsequent effect on attacking troops. During the period of preparation, many hostile batteries will be located in areas beyond the immediate objective or in areas that can be easily identified and avoided by the attacking force. The use of persistent vesicants on these targets will force the enemy to move at a time most advantageous to our attack, or suffer casualties if he remains.

b. After the attack has been launched and the artillery fire enters the support phase, the employment of chemicals by the artillery will be limited largely to firing smoke to deny artillery observation by the defending force. Other agents will be employed only to a very limited extent in continuation of the neutralization missions on the flanks and rear as stated in *a* above.

■ 42. IN THE DEFENSIVE.—*a.* In the initial phase of the defense, prior to the time the enemy actually begins his artillery preparation for the attack, chemical agents of the persistent vesicant type are used freely to interdict roads and other approaches likely to be used by the enemy in preparation for and during his attack. These agents may also be effectively employed to neutralize large areas, including flank positions, that the enemy may use in launching or prosecuting his attack. Such missions are usually executed prior to the time of the requirement for high explosive missions.

b. During the hostile preparation for the attack the persistent vesicants are used in artillery fires in continuation of the missions described above. However, the most important missions during this phase will be the firing of persistent vesicants for counterbattery and to deny to the enemy the use of favorable avenues of approach and the use of smoke to deny hostile artillery observation.

c. After the enemy has launched his attack, chemical agents that are effective in low concentrations are used against moving targets. Irritant agents are effectively used in this phase to force the enemy to mask, thus hindering his operations.

■ 43. In Stabilized Situations.—Chemical agents of all types are used by the artillery in stabilized situations where more time will be available for supplying large quantities of ammunition needed for extensive operations. Hence it will be possible in these situations to fire nonpersistent agents more extensively on rear areas occupied by supports and reserves, to fire persistent vesicants on large occupied areas, to fire smoke to deny observation, and to fire irritant agents from day to day to harass the enemy and weaken his morale.

Section IV

CAVALRY

■ 44. General.—Since the chief characteristic of Cavalry is mobility, fire power, and shock action, its success is in general dependent upon aggressive action in rapidly changing situations. Accordingly, the chemical munitions that can be employed by Cavalry without sacrificing mobility are limited in kind and in quantity. Although the ability for quick withdrawal from one position and surprise action elsewhere is generally not favorable for the employment of casualty chemical agents, it does present unusual opportunity for the extensive use of smoke in both local and large-scale operations. Casualty and incendiary agents are also useful to Cavalry when the operations are large enough to justify support from artillery, chemical troops, and air force elements. The information in this section applies equally to horse and mechanized Cavalry.

■ 45. Chemical Weapons and Matériel.—The weapons available to Cavalry are—

a. For use by cavalry troops—
81-mm mortar (WP) (FM 23–90).
Grenades (WP, CN–DM ,TH) (FM 23–30).

b. For use by supporting troops—
75-mm artillery (sec. III).
4.2-inch chemical mortar (sec. I).
Airplane bombs and spray (sec. V).

(The military characteristics of the matériel are to be found in FM 101–10 and appendix V. For description and function, see the Field Manuals, Technical Manuals, or Technical Regulations indicated.)

■ 46. MOBILITY.—Use of chemical agents by Cavalry troops themselves, when operating without support, is limited by their organic weapons and the fact that it is not feasible to burden Cavalry with additional weapons which would reduce the desired mobility. However, when Cavalry is engaged in large scale operations, supporting weapons should be called upon and, in addition to firing smoke, these other weapons will assist with nonpersistent and persistent agents and incendiaries. In small local encounters Cavalry will be able to make free use of smoke released from grenades and its own 81-mm mortars, and will have occasional use for irritant and incendiary grenades in dismounted action.

■ 47. FIRE POWER.—Chemical agents may be employed to aid the fire power of Cavalry in various situations.

a. Smoke may be used to screen forward movement of Cavalry troops and to aid in protection of the flanks.

b. When it is necessary for Cavalry to slow down in passing through defiles, vulnerability will be lessened by screening with smoke to prevent observation and aimed fire.

c. Blocked defiles may be forced by the use of nonpersistent agents provided it is not necessary for our own troops to use the area during the period of persistence of the agent.

d. In crossing open spaces, particularly in emerging from woods, smoke will cover the movement and prevent aimed fire.

e. Incendiary grenades can be used to drive hostile troops from fields and woods, and in local mopping-up operations.

■ 48. SHOCK ACTION.—Chemical agents will assist in furthering shock action by—

a. Decreasing the effectiveness of hostile fire preceding collision, thereby decreasing the number of casualties resulting when crossing a fire-swept zone and helping to preserve the integrity of units.

b. Screening the movements into positions prior to attack, thereby obtaining or maintaining the element of surprise (fig. 15).

c. Screening the main effort or decisive attack during the approach phase, thereby not alone maintaining the element of surprise, but also in many cases saving the horses

during this phase with a view to their greater utilization in the attack proper (figs. 15, 16, and 17).

■ 49. CAVALRY VS. CAVALRY.—In the usual forms of action of both offense and defense, chemicals will not often be used. When they are, they will be confined to smoke and nonpersistent agents such as the lacrimators. In special operations requiring purely passive measures, such as the blocking of a defile or the defense of a river line, the use of chemical agents will apply equally against Cavalry and against less mobile forces, and will include persistent agents.

■ 50. CAVALRY VS. CAVALRY IN THE OFFENSIVE.—Smoke for screening purposes, and possibly nonpersistent harassing agents mixed with smoke to force masking, projected by mechanized 4.2-inch chemical mortars, may be used to support offensive cavalry action. Due to the limited time involved and the changing situations, other chemical agents seldom can be employed without adversely affecting our own troops. (See fig. 18.)

■ 51. CAVALRY VS. CAVALRY IN THE DEFENSIVE.—Smoke is of assistance in covering withdrawals to successive positions. Since considerable smoke will be necessary for such operations, additional support should be furnished by chemical troops employing the 4.2-inch chemical mortar.

■ 52. CAVALRY IN THE OFFENSIVE VS. LESS MOBILE FORCES.—Chemicals in the form of smokes and nonpersistent agents may be valuable in screening the approach of the main effort and decreasing the effectiveness of hostile fire against both the secondary and main efforts. In general, chemical troops should be attached for these operations to provide the necessary chemical support. Persistent agents cannot be employed, as the attack will be carried through to a decision before they are sufficiently dissipated.

■ 53. CAVALRY IN THE DEFENSIVE VS. LESS MOBILE FORCES.—*a*. During the development and deployment of the hostile force, the employment of nonpersistent agents will harass, delay, and disorganize enemy preparation. Persistent agents may also be used if there is no possibility that our own troops will be forced to traverse the terrain.

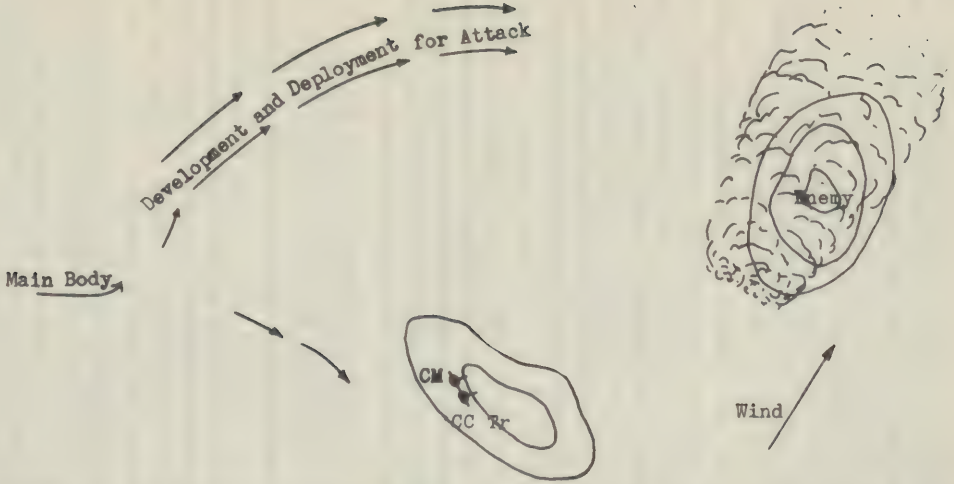


FIGURE 15.—Use of smoke to screen development and deployment. Smoke may be similarly used with a view to deceiving as to direction of attack when made from an unexpected point.

FIGURE 16.—Use of smoke to screen initial movement of main body to natural cover.

b. By employing nonpersistent agents during the initial phase of the hostile attack, it is possible to disrupt command and communications, and increase the difficulties of maintenance of direction. Persistent agents may be used under the same conditions as noted in *a* above.

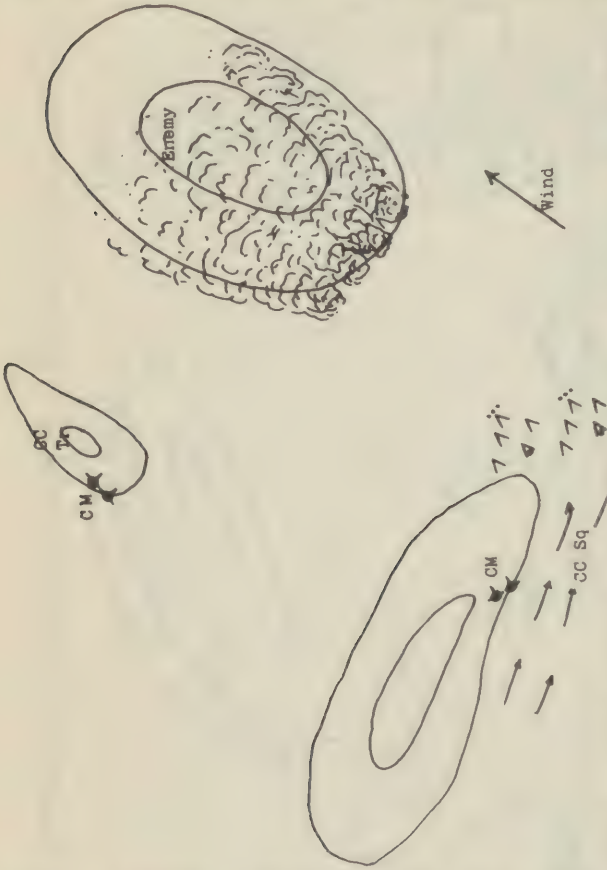


FIGURE 17.—Same situation as that shown in figure 16 with smoke shifted so that it actually screens main attack. Smoke is preferably projected by chemical mortars attached to combat car squadron.

c. By employing smoke on the leading elements of the enemy during the withdrawal from positions, the delaying positions may be occupied for a longer time and casualties

FIGURE 18.—Use of smoke to cover attack by combat car squadron. For this purpose smoke can best be laid by chemical mortar attached to combat car squadron. With a view to better coordination with supporting artillery fire, smoke might be laid by chemical mortar attached to combat car troop or by mortars held for general support.

incurred during the actual withdrawal of units will be decreased.

d. During attacks against the flank or flanks of the hostile main body by the maneuvering force, which will in general be mainly by fire action for the purpose of creating further confusion and delay in the hostile development and deployment, chemicals in the form of nonpersistent agents may be used advantageously for harassing, and smoke may be used to cover the withdrawal of the attacking units. Persistent agents may be employed under the same conditions as noted in *a* above.

e. It may frequently be necessary to call for chemical support from chemical troops, artillery, engineers, or air force for many of the foregoing operations.

■ 54. RAIDS.—The attack and withdrawal may be advantageously screened with smoke.

■ 55. DEFENSE OF A RIVER LINE.—Persistent agents can be used for interdicting the terrain on the enemy's bank and the forming and embarking areas prior to the attempted crossing. Nonpersistent agents used on troops attempting the crossing will cause much added confusion and disorder, the chances of a successful crossing thus being greatly lessened. Smoke may be used to blind enemy observation and to screen the withdrawal of our own troops if this becomes necessary, but smoke should not be used on hostile troops which are targets for aimed fire.

■ 56. COMPLETELY DISMOUNTED ACTIONS.—When cavalry troops operate completely dismounted their tactical procedures are the same as for Infantry, and the use of chemical agents in these situations is explained in section II.

■ 57. PERMANENT WITHDRAWALS.—When cavalry troops withdraw from an area that will not be occupied by our troops for a considerable period of time, the chemical land mine is effective in delaying the enemy's advance. These mines are laid by engineer and chemical troops. (See fig. 19.)

SECTION V

AIR FORCE

■ 58. GENERAL.—*a.* The air force is both a strategical and tactical unit. Its purpose in air attack is to destroy or neu-

tralize surface objectives, particularly those which cannot be reached effectively by other weapons. Chemical munitions are a means for both destruction and neutralization. Incen-

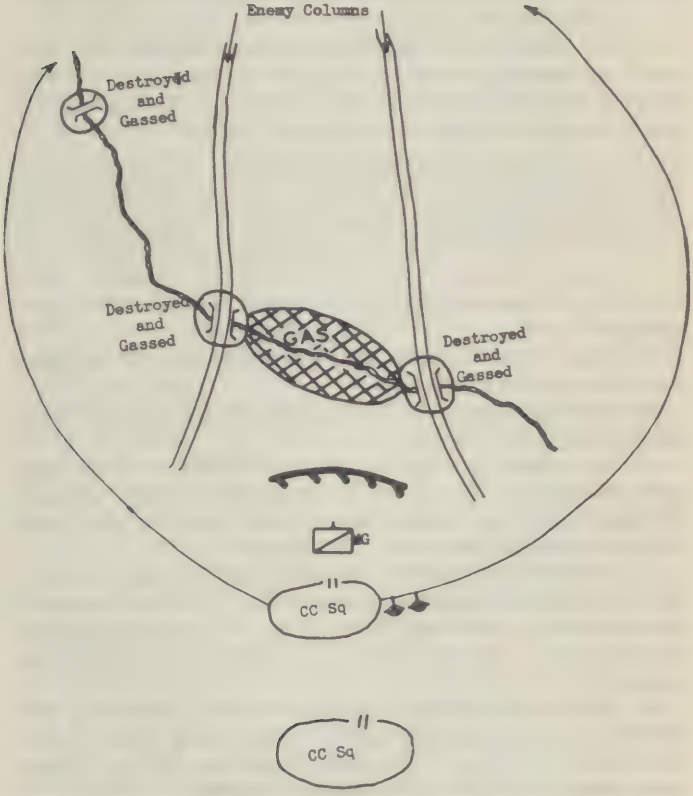


FIGURE 19.—Delaying action in which chemical agents have been used to augment demolitions accomplished by engineer troops and to interdict probable routes of advance. Chemical mortar detachment is now prepared to cover withdrawal with smoke.

diaries are suitable agents for destruction, particularly against strategic targets. Gas and smoke are effective agents for neutralization. Air chemical attacks are capable of maximum effectiveness in shattering enemy resistance because they can

be directed against the most vulnerable elements of the enemy's strength.

b. Air chemical attack technique includes bombing and low, medium, and high altitude spraying. Appropriate techniques are described in **FM 1–10.**

c. The objectives of air attack are stated in **FM 1–10.** Chemical munitions can be employed to advantage in most situations, either as the principal weapon or to augment the effects of demolition or fragmentation bombs.

■ 59. AIRPLANES AND CHEMICAL ARMAMENT.—The bomber and support components of an air force are its offensive power. The former is charged with destroying hostile strategic objectives, the latter with operations principally in direct support of ground forces. The munitions for air chemical attack are chemical bombs, incendiary bombs, and chemical spray tanks.

a. Airplanes.—The military characteristics of airplanes are given in **FM 101–10.**

(1) The **B26** and **B24C** are typical of medium and heavy bombardment airplanes.

(2) The **A20B** is a typical offensive airplane of the support component. It is a two-engined light bomber equipped for mounting four nonpressure spray tanks on its wings. The bomb load is carried in the fuselage.

b. Chemical armament.—The chemical armament of the air force includes bombs and spray tanks. The military characteristics may be found in Appendix V, and technical description and related material in the Technical Manuals indicated.

(1) *30-pound chemical bomb M1.*—This bomb is filled with either persistent casualty agents or obscuring smoke (WP). When filled with the latter agent, it may be used as a scatter type incendiary. (See TM 9–980 and 3–330.)

(2) *30-pound chemical bomb M46.*—This is a thin-case bomb of very high chemical efficiency. It is filled with persistent casualty agents. (See TM 9–980.)

(3) *100-pound chemical bomb M47.*—This is a thin-case bomb similar in design to the M46. Persistent casualty agents and oil incendiary fillings are furnished. (See TM 3–330.)

(4) *4-pound incendiary bombs.*—These are intensive type incendiaries. They are grouped in clusters for loading into airplane bomb racks, thus combining a scatter characteristic with their intense incendiary action. (See TM 3–330.)

(5) *Airplane spray tanks.*—Spray tanks are of two general types, pressure and nonpressure. When smoke is used, the pressure type produces a curtain of smoke whereas the nonpressure tank produces a cloud. Persistent casualty, harassing and smoke agents may be dispersed from spray tanks. There are three standard chemical spray tanks: 33-gallon airplane smoke tank M10 (nonpressure); 50-gallon airplane smoke tank M20 (pressure); and the 30-gallon airplane smoke tank M21 (pressure). Their military characteristics are to be found in appendix V.

■ 60. AGENTS EMPLOYED.—*a. Nonpersistent casualty agents.*—Agents such as phosgene (CG) may be used against personnel in suitable bombs. The munitions must be dropped in sufficient quantity to deliver 400 to 500 pounds of agent per 10,000 square yards of target area. Small targets should not be engaged. The bombs should be placed within the target area and a short distance up wind of it.

b. Persistent harassing agents.—Chloracetophenone solution (CNS) may be used in spray tanks against personnel (fig. 1). It has the advantage of extremely rapid action and is temporarily incapacitating to unmasked personnel. The usual distribution of droplets of liquid agent on the clothing and equipment of the attacked troops persists for several hours and enforces masking for that period. However, unless the troops to be attacked are in an extremely forward area on ground that our troops occupy or necessarily pass over within 2 or 3 days of the attack, persistent vesicants would be of much greater value.

c. Persistent casualty agents.—(1) Persistent vesicants, being liquid agents, are suitable for use in spray tanks and bombs. Mustard (HS), lewisite (M–1), or a mixture of these agents may be used, the selection being somewhat dependent upon temperature, the rapidity of physiological action, and the degree of persistence desired. When sprayed, these agents produce a wide distribution of liquid droplets which

will cause a large proportion of casualties to exposed personnel. The persistence under these conditions will not be high, usually 4 to 6 hours in summer and 24 hours in winter. Spray attacks are used against personnel rather than to neutralize terrain.

(2) Chemical bombs, filled with persistent vesicants, may be used after the employment of high-explosive bombs to contaminate the debris resulting from the destructive effect of the high explosive. They may be used alone to neutralize terrain or contaminate supply dumps or depots. Greater persistence will result from the use of vesicant filled bombs than with spray, and it will vary with the amount of agent dispersed and the meteorological conditions. Persistence varies from about 24 hours in summer to several weeks in winter.

d. Smoke agents.—(1) Sulfur trioxide solution (FS) is a liquid used in spray tanks to produce smoke screens of great extent in a minimum of time. Under favorable meteorological conditions the smoke clouds thus produced will hang together for a considerable period, drifing with the wind (fig. 20).

(2) White phosphorus (WP) is a suitable filling for most chemical bombs. A dense white smoke is produced which travels down wind from the point of impact of the bomb. Smoke is produced from the WP fragments of the M1 bomb for about 6 minutes. The duration of the smoke varies with meteorological conditions and the nature of the soil at the point of impact.

e. Incendiary agents.—Incendiary bombs are employed against combustible structures of industrial areas, combustible supplies, and hostile air bases. They should not be used in conjunction with persistent or nonpersistent agents as the heat generated renders the gas ineffective. However, an attack with nonpersistent agents may precede the incendiary operation. WP or oil-filled bombs may be used to ignite dry woods, grass, crops, etc. Incendiary leaves may be employed for the same purpose. They are distributed in bulk or in a bomb similar to the M47, which bursts in the air. Small magnesium and thermite bombs are employed against metropolitan areas or where little accuracy in bombing is required.

FIGURE 20.—Airplane smoke screen.

■ 61. COUNTER AIR FORCE AIR CHEMICAL OPERATIONS.—Although chemical means are not effective for combating hostile air elements while they actually are in the air, chemical agents have several effective counter air force functions against air bases and air force elements and personnel on the ground.

a. Persistent casualty agents, both in bombs and as spray, may be used for casualty effect against personnel and for contamination of ground and matériel.

b. Incendiary munitions of the intensive type should be used against gasoline and oil storage facilities.

c. In attacks against dispersed enemy air bases, where wood or other combustible material is used for concealment of airplanes, supplies, and maintenance facilities, scatter type incendiaries should be used to ignite the cover.

■ 62. AIR CHEMICAL OPERATIONS AGAINST STRATEGIC OBJECTIVES.—Strategic objectives include facilities and establishments which support the operations of the enemy's armed forces and the enemy national structure. They also include elements of the armed forces not engaged in tactical operations. Against matériel objectives, destruction is the principal effect desired. Where such matériel is combustible, incendiaries should be used in conjunction with demolition bombs. If the matériel is not readily combustible, persistent casualty agents should be employed with demolition bombs, to hamper the rehabilitation of the area. Against personnel, either nonpersistent or persistent casualty agents should be used in conjunction with demolition or fragmentation bombs. When so used the chemical attack should follow the destructive attack. Smoke may be used in daylight operations to blind hostile antiaircraft weapons.

■ 63. AIR CHEMICAL SUPPORT OF GROUND FORCES.—The air force in support of ground forces operates in a manner that will most effectively contribute to the successful execution of the ground force mission. Chemical attack is of material assistance in the execution of these operations. Air attack is directed against objectives which cannot be practicably engaged by other means in the time available or when added fire power and moral effect are essential.

a. In support of offensive action.—Nonpersistent casualty agents, in bombs, may be used against enemy personnel in forward areas. Persistent casualty agents may be used in spray attacks against personnel in rear areas. They may likewise be used on rear area installations such as long range artillery, ammunition dumps, and depots. Incendiary bombs of the scatter type should be employed to ignite combustible cover of strong defensive localities when such fires will not interfere with the advance of our own forces (par 18*e*). In support of armored force attack, smoke may be employed to reduce the effectiveness of hostile antitank weapons. Such smoke missions should be accomplished with bombs rather than with spray to localize the smoke and increase the time of its effectiveness. In landings on hostile shores the supporting air force should employ both spray and bombs to produce smoke screens. Spray is employed where smoke is placed over water and bombs are used on land areas.

b. In support of defensive action.—In defense against enemy infantry attack, nonpersistent casualty agents, in bombs, may be used against personnel in assembly areas or forming for attack to produce casualties and disorganization. Spray and bomb attacks with persistent casualty agents are effective against motor and troop columns on roads. Chemical barriers may be rapidly created by air forces using bombs filled with persistent casualty agents. Smoke in bombs, and harassing agents sprayed, are effective against enemy armored attack in delaying and disorganizing the armored force advance. Scatter type incendiary bombs may be used to drive hostile support weapons out of combustible cover.

SECTION VI

ENGINEER TROOPS

■ 64. GENERAL.—*a.* Engineer troops will find chemical agents of great value in the performance of certain operations such as—

(1) Destruction of field fortifications.
(2) River crossings.
(3) Creation of obstacles.
(4) Destruction of matériel.

b. When engineers are engaged on infantry missions, they employ chemical agents in a manner similar to infantry troops. (See sec. II.)

■ 65. MUNITIONS EMPLOYED.—The chemical munitions employed by engineers are—

a. Smoke, irritant, and incendiary grenades.

b. Chemical land mines.

c. Flame throwers.

■ 66. DESTRUCTION OF FIELD FORTIFICATIONS.—*a.* When engaged in these operations, engineer troops may employ various kinds of chemical munitions to advantage depending upon the particular type of task involved.

b. When it becomes desirable to destroy barbed wire entanglements by means of bangalore torpedoes during daylight hours, the use of smoke will permit artificial cover against hostile fire. In small operations and under favorable wind conditions this cover can be provided by means of smoke grenades. In large scale operations or unfavorable wind conditions, it will be necessary for engineer troops to have the assistance of other troops equipped with mortars suitable for firing smoke shell.

c. In attacks against permanent field fortifications in which task units are employed and of which engineer troops form the principal arm, several types of chemical munitions may be employed advantageously, depending upon the construction of the fortification and the nature of the terrain. Smoke will be effective in screening the operation and reducing the effectiveness of hostile fire. Irritant grenades will cause the defenders to wear gas masks and thereby reduce their efficiency. Incendiaries projected from grenades or flame throwers fired at the hostile embrasures are effective in destroying resistance. In view of the required coordination of the various components of these task units to obtain the necessary element of surprise and shock action for success, these operations should be well rehearsed on terrain and against a dummy fortification similar to the one to be attacked.

■ 67. RIVER CROSSINGS.—Although engineer troops perform a predominant part in river crossings, nevertheless it is a combined arms operation (fig. 21). For the tactical use of smoke in river crossings see paragraph 22.

■ 68. OBSTACLES.—*a*. Road blocks, obstacles, and barriers may be contaminated by persistent gas, thereby producing a combined rigid and chemical obstacle or barrier which is more effective. To remove such obstacles troops must be hampered

FIGURE 21.—Smoke covering river crossing.

by protective clothing and be provided with special equipment, or suffer severe casualties. This contamination work will normally be performed by chemical troops employing chemical land mines. When the latter troops are not available, this task may be performed by engineer troops.

b. Chemical obstacles or barriers will be extensively employed in defensive operations and retrograde movements. (See pars. 19 and 21.) These tasks may be performed by engineer troops or by chemical troops when available.

■ 69. DESTRUCTION OF MATÉRIEL.—In retrograde movements engineer troops supply the major service in the destruction of such abandoned matériel as may be of value to the enemy. For the burning of woods, wooden buildings, ripe grain fields, and other inflammable matériel, incendiary munitions in the form of grenades and flame throwers can effectively be employed.

CHAPTER 3

CHEMICAL STAFF OFFICER

■ 70. ASSIGNMENT.—*a*. Chemical warfare staff officers are officers of the Chemical Warfare Service assigned to the staffs of the commander of a division, corps, army, GHQ, corps area, or department. In special cases assignment may be made to other commands. Divisions and higher units have both a general staff and a special staff. Chemical warfare staff officers are members of the special staff and are known as chemical officers.

b. In units below the division, staff officers from the arms concerned are assigned to perform chemical duties primarily concerned with protective measures. They are designated as gas officers of their regiments, battalions, and similar units in other arms and services.

c. Chemical personnel are assigned to divisions, air bases, and higher echelons of the ground and air force as prescribed in appropriate Tables of Organization. Officers so assigned belong to special staffs of their respective units, the senior being designated as the chemical officer thereof. Enlisted men so assigned compose the chemical section of the unit.

d. Chemical officers are expected to acquaint themselves with the general duties of staff officers. For the general principles governing the functions of the general staff group and the special staff, see FM 101–5.

■ 71. GENERAL DUTIES.—*a*. Staff duties are mainly advisory to the commander and his general staff group. As a staff officer, the chemical officer has no authority to command. Authorized directions issued by him are given in the name of his commander.

b. The chemical officer is vested with authority by the commander to make technical inspections in subordinate units and call for technical reports from special staff officers performing similar duties. With the utmost cooperation he should advise in all chemical matters and assist subordinate commanders to comprehend the exact desires of the superior whom they all serve to a common end.

c. The scope and magnitude of the general duties and responsibilities of chemical officers vary with the size of the command to which the chemical officer is assigned. They are as follows:

(1) Advising the commander and staff on all chemical matters, including the use of chemicals by the various arms.

(2) Supervision, within limits prescribed by the commander, of all chemical training, including necessary inspections.

(3) Collection, and such evaluation and distribution as the commander may prescribe, of information concerning means and methods of utilization of chemicals by the enemy and our own troops, the nature thereof, and the results obtained therefrom.

(4) Supply of chemical matériel except chemically filled ordnance ammunition.

(5) Repair of chemical equipment and supplies and supervision of salvage of such equipment.

(6) Technical inspections of chemical supplies, equipment, and ammunition within limits prescribed by the commander.

(7) Supervision of the filling of such chemical munitions as may be prescribed for performance in the theater of operations.

(8) Supervision of the operations of assigned and attached chemical service units.

(9) Planning the operations of chemical troops.

(10) Supervision of collective protective measures, including decontamination.

d. For additional information on the duties of supply and protection and training, see FM 3–15 and 21–40.

■ 72. RELATIONSHIP TO CHEMICAL TROOPS.—The division or higher unit chemical officer does not command chemical troops which may be attached, but it is usually upon his recommendation and technical advice that the attachment is made. Since the unit chemical officer prepares plans for and recommends to the unit commander the use of these troops, close cooperation between these two officers is necessary for proper employment of the troops. It is through the chemical staff officer and not the troop officer that the commander and his staff obtain information and advice for chemical troop operations.

■ 73. RELATIONS WITH STAFF.—The chemical officer must keep in close contact with all members of the staff. He must be prepared to advise and assist in all situations where chemical warfare influences the activities of the other staff sections, and must consult with these sections in the performance of his duties. He keeps an enemy situation map and an operations map showing all chemical operations.

■ 74. RELATIONS WITH UNIT COMMANDERS.—The chemical officer maintains close contact with the commanders of subordinate units. He advises and assists them in their problems of training, protection, and the employment of chemicals.

CHAPTER 4

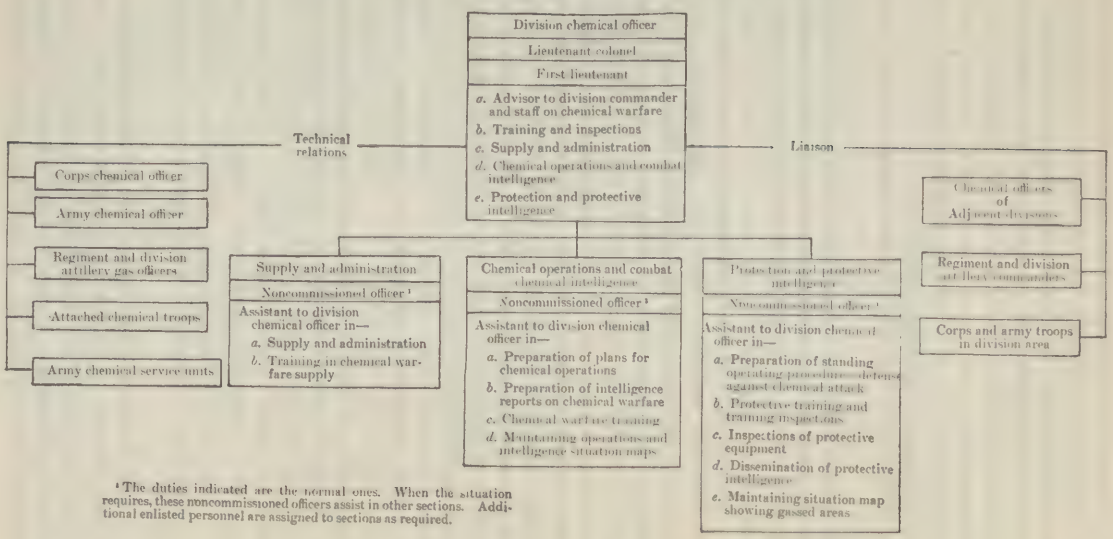
CHEMICAL STAFF OFFICER WITH ARMY GROUND FORCES

SECTION I

DIVISION CHEMICAL OFFICER

■ 75. ORGANIZATION OF STAFF SECTION.—The interior organization of the chemical staff section of a division will differ with the command to which it is assigned. Based on functional considerations, it may be divided into three subsections: supply and administration, chemical operations and combat intelligence, and protection and protective intelligence. The division chemical officer must perform all of these functions. Although a noncommissioned officer may be assigned to head a section, he serves only as an assistant for the particular activity to which he is assigned. The duties of personnel in each section, however, cannot be rigidly confined to their respective assignments as necessity may demand that all personnel be temporarily concentrated on one activity. The necessity of forming a forward and rear echelon of the chemical section will depend upon the tactical situation and the desires of the division commander. The following chart shows, in general, how a chemical section of a division may be organized.

DIVISION CHEMICAL OFFICER, FUNCTIONS AND ORGANIZATION



[1] The duties indicated are the normal ones. When the situation requires, these noncommissioned officers assist in other sections. Additional enlisted personnel are assigned to sections as required.

■ 76. DUTIES OF DIVISION CHEMICAL OFFICER.—*a. Protection against chemical agents.*—(1) Institution of chemical warfare schools within the division and, if necessary, a systematic arrangement for sending unit gas officers (or their prospective replacements) to schools provided by higher headquarters.

(2) Supervision of training throughout the division in defense against chemical attack.

(3) Attainment of the highest possible state of gas discipline.

(4) Preparation of the division plan and standing operating procedure for protection against chemical agents.

(5) Inspection of measures for protection against chemical attacks.

(6) Supervision of the decontamination of gassed areas.

b. Chemical warfare offensive operations.—(1) *Functions.*—The functions of the division chemical officer with regard to chemical warfare offensive operations consist of training, planning, and advice. He is consulted in the preparation of plans or any extensive use of chemical agents in order to prevent injury to his own troops through ill-timed or unsafe use, and to secure the most effective and economic use of the agents available. In this work the division chemical officer maintains close contact with G–3 and acts as an advisor to the division artillery officer and Army Air Forces commander and their respective operations officers. He must keep thoroughly informed of the enemy situation and his own commander's plans. He must also know the kind and quantity of chemical ammunition and the quantities of bulk chemical agents available for offensive operations.

(2) *Chemical annex to field orders* (app. IX).—(*a*) The division chemical officer is responsible for the preparation of the chemical annex to field orders, that is, the detailed plan for the use of chemical troops. After the annex is prepared, it is submitted through G–3 to the division commander for approval.

(*b*) The division chemical officer keeps in constant touch with the situation with a view to aiding the plan of his commander by a judicious use of chemical agents. He anticipates the use of chemical troops and advises the division commander of the desirability of requesting their attachment.

(*c*) Before any plan for the employment of chemical troops is prepared, the division chemical officer makes a complete estimate of the situation. The scope of the estimate varies with the situation and the size of the unit concerned. In general, it is broader in scope and less detailed for large units than for small ones. The general form for an estimate of the situation is shown in appendix VIII.

(*d*) In large operations the general plan will come from the corps to the division chemical officer so that the latter can coordinate the division plan with that of the corps.

(3) *Relation to chemical warfare troops.*—As a member of the staff, the division chemical officer initiates chemical warfare operations for the division; but he does not command the chemical troops who carry out those operations. He is, however, the intermediary between the chemical troops and the division commander.

(4) *Situation map.*—He maintains a situation map to keep informed of the general situation. This map should show the areas gassed by our own troops and those gassed by the enemy, and the kind of agents used.

c. Chemical warfare intelligence.—(1) The division chemical officer is charged with the collection, evaluation, and distribution of information relative to the enemy's development and use of chemical agents, as well as with the dissemination of information concerning new developments by our own army.

(2) Information of the enemy falls under four main headings, as follows:

(*a*) The development by the enemy of new agents, matériel, methods, or tactics of chemical warfare.

(*b*) The prospective enemy use of chemical agents on the division front.

(*c*) The enemy order of battle, distribution of chemical troops, batteries, and other installations.

(*d*) The state of gas discipline, equipment, and morale of various enemy units.

(3) Local information of enemy developments is obtained from air and land reconnaissance, interrogation of prisoners, and from the examination of captured installations, matériel, and munitions. Samples of chemical agents, gassed earth, chemical shell, fuzes, and other items, as well as masks and

protective equipment, are obtained from all possible sources. See FM 3–25 for forwarding channels for various classes of enemy matériel.

(4) Intelligence summaries and bulletins issued by the Chemical Service, GHQ containing information on general chemical warfare developments and the results of late research and experimentation are furnished the division chemical officer for distribution to all concerned.

(5) The preparation of statistical records of both the enemy's and our own gas attacks is an important duty of the division chemical officer. The data required include the weather conditions, the time, place, and duration of the attack, munitions employed, area and number of troops affected, protective measures taken, and the number, types, and seriousness of casualties. This information is obtained piecemeal and incomplete from such sources as G–2, the artillery, chemical troops, Medical Department, and unit gas officers. It is assembled and transmitted to higher headquarters for study and record.

(6) Special attention must be paid to the maintenance of records of all mustard-gassed areas, whether within our own or the enemy's territory.

d. Chemical warfare supply.—(1) The duties of the division chemical officer relative to supply are limited to receiving, storing, and issuing chemical warfare protective supplies for the division. It is his duty to insure that the division is properly equipped and that an adequate reserve supply is maintained.

(2) The division chemical officer makes frequent inspections in order to know at first hand the condition and supply of equipment used for individual and collective protection.

(3) A division distributing point or dump is the only supply installation maintained by the division chemical officer. Stores are kept at a minimum, approximately equivalent to 5 percent over actual requirements.

(4) The units of the division draw on the division chemical dump on the basis of approved requisitions.

■ 77. CONTACTS WITH COMMANDERS AND STAFF.—The division chemical officer maintains close contact with commanders of units within the division and with the division staff. The contacts made with the general staff will normally be made

by the division chemical officer in person, and with the division commander if specifically requested by the latter. Contacts with the commander or subordinate units and with the special staff may be made by the division chemical officer or by his assistants, depending upon the importance of the mission.

■ 78. CONTACTS WITH DIVISION COMMANDER AND GENERAL STAFF.—Relations with the division commander are of an advisory nature. Unless called for personally by the division commander, contact will usually be maintained through the general staff sections. The same situation exists in regard to relations with the chief of staff. The chemical officer's relations with the general staff sections are similar to the relations of any other member of the special staff with these sections. He communicates with the personnel section with reference to personnel for chemical troop units; with the intelligence section with reference to information on the employment of chemicals by the enemy; with the operations and training section with reference to the training of chemical troops and the training of all personnel in protection and the employment of chemicals; and with the supply section with reference to the supply of chemical equipment, both offensive and defensive, to units assigned or attached to the division.

■ 79. CONTACTS WITH SPECIAL STAFF SECTIONS.—The division chemical officer must maintain close contact with the majority of the special staff sections. His principal interests with members of the supply services are the protection of supply personnel against gas attacks and the protection of supplies and equipment from gas contamination. It will be necessary for him to maintain close contact with the artillery officer, the air force officer, and in some situations the engineer officer, concerning the employment of chemicals by these units. He also may consult the division surgeon on questions of protection and first aid for the entire command, and the provost marshal on the guarding of gassed areas and the enforcement of certain standing orders against gas.

■ 80. CONTACTS WITH THE COMMANDERS OF SUBORDINATE UNITS.—Contacts with the commanders of subordinate units

are made with the approval of the next higher commander. The relations with these units include training in chemical warfare, protective measures against hostile chemical attack, inspections of protective equipment and installations, the supply of protective equipment, and the appointment of suitable personnel as unit gas officers and gas noncommissioned officers.

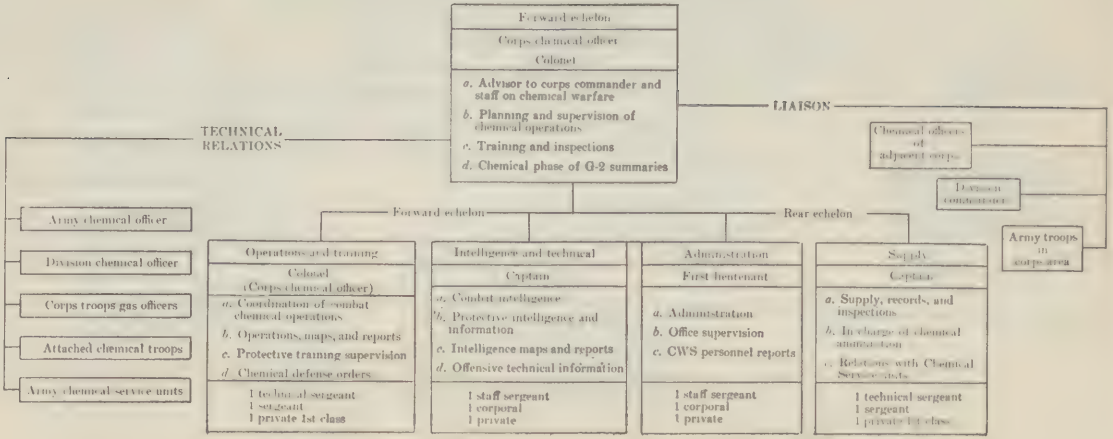
SECTION II

CORPS CHEMICAL OFFICER

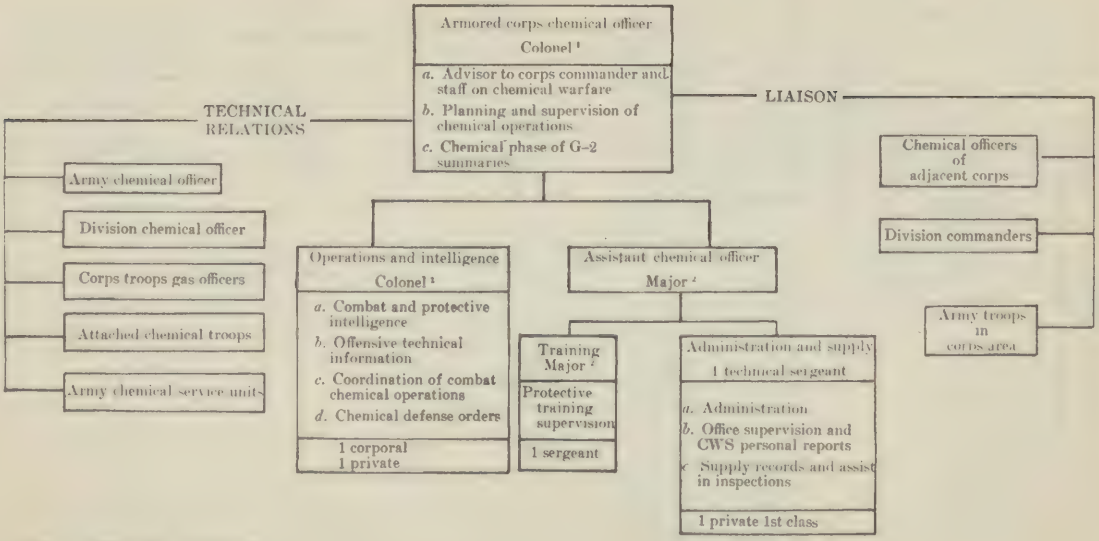
■ 81. ORGANIZATION OF STAFF SECTION.—The chemical warfare staff section of a corps is organized along the same general functional lines as the division, with certain variations due to differences in assigned personnel. Organization of the armored corps chemical staff section is generally the same as for that of the armored division. Organization for the chemical section of the army corps is shown in the following tables:

CORPS CHEMICAL OFFICER, FUNCTIONS AND ORGANIZATION

(T/O 100-1)



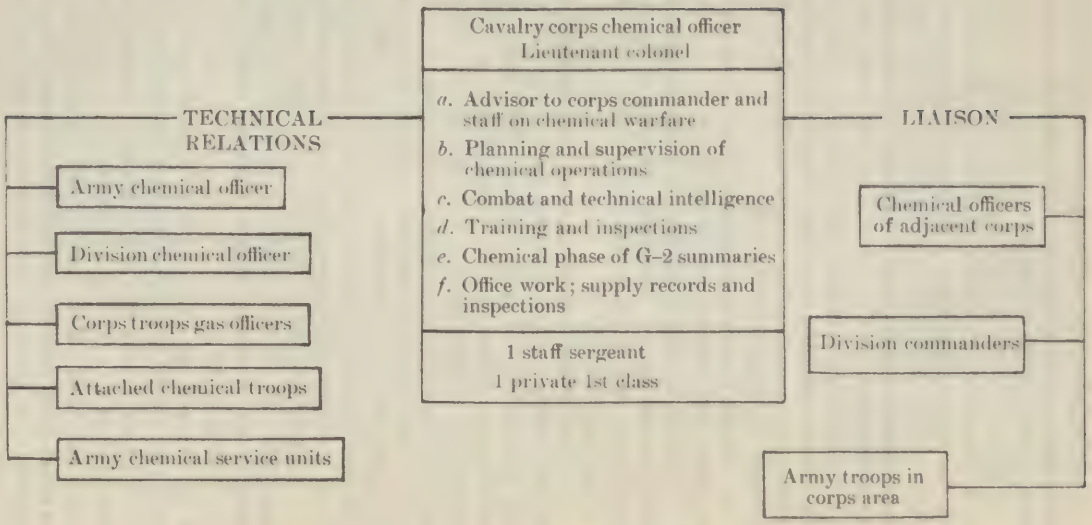
T/O 170–1



[1] Same officer in command.
[2] Same officer in command.

CAVALRY CORPS CHEMICAL OFFICER, FUNCTIONS AND ORGANIZATION

T/O 150–1



a. Administration.—This section is charged with office supervision, administration of Chemical Warfare Service personnel, and routine reports.

b. Intelligence and technical.—(1) This section is charged with the collection, evaluation, and transmission of technical and tactical information, and with the coordination of chemical warfare intelligence activities of the divisions. The corps chemical section has a wider scope of action than that of the division.

(2) The corps chemical officer receives from division chemical officers samples of enemy agents and matériel which are given close examination and are disposed of in accordance with the provisions of FM 3–25.

(3) Other intelligence duties are as described in connection with the division chemical officer.

c. War plans and operations.—This section is charged with the supervision of chemical warfare training for corps troops through conduct of corps schools and corps chemical warfare operations.

(1) The operations function of this office differs from that of the division chemical office in that it has greater scope and magnitude. It is the duty of this office to recommend and prepare plans for the employment of chemical agents against all targets within that portion of the enemy territory designated as the normal corps zone.

(2) The chemical warfare protective function includes measures for the protection of all units and installations, whether combat or supply, within the corps area.

(3) During active operations the corps establishes chemical warfare schools to instruct unit gas officers when it is impossible for the division to make such provision. The supervision of such schools is placed under the plans and operations section.

■ 82. DUTIES OF CORPS CHEMICAL OFFICER.—*a.* The corps chemical officer occupies the same position on the corps staff as has been described for the division chemical officer on the division staff. So far as corps troops are concerned the corps chemical officer has the same duties and relationships as those described for the division chemical officer and division troops. In general, however, the scope of these duties is broader due to the increased responsibilities of a corps.

b. The corps chemical officer has no command over the division chemical officers, but through the corps and division commanders he exercises technical control.

Section III

ARMY CHEMICAL OFFICER

■ 83. Organization of Staff Section.—The army chemical staff section is organized as shown in the following table:

ARMY CHEMICAL OFFICER. FUNCTIONS AND ORGANIZATION

T/O 200-1

FORWARD ECHELON
INTELLIGENCE AND TECHNICAL
CAPTAIN
A. COMBAT AND TECHNICAL INTELLIGENCE
B. INTELLIGENCE MAPS AND REPORTS
C. COLLECTION STUDY AND TRANSMISSION OF INFORMATION ON DEVELOPMENTS OF THE CWS
1 SERGEANT
1 PRIVATE 1ST CLASS
OPERATIONS AND TRAINING
MAJOR
A. PLANNING, SUPERVISION, AND COORDINATION OF CHEMICAL OPERATIONS
B. CWS TRAINING SCHOOLS
C. OPERATIONS MAPS AND REPORTS
D. CHEMICAL DEFENSE ORDERS
1 TECHNICAL SERGEANT
1 CORPORAL
ARMY CHEMICAL SERVICE UNITS
REAR ECHELON
ASSISTANT ARMY CHEMICAL OFFICER
MAJOR
ADMINISTRATION SUPPLY
1 STAFF SERGEANT
REAR ECHELON
ADMINISTRATION
FIRST LIEUTENANT
A. ADMINISTRATION
B. OFFICE SUPERVISION
C. CWS PERSONNEL REPORTS
1 TECHNICAL SERGEANT
1 CORPORAL
2 PRIVATES
SUPPLY
CAPTAIN
A. IN CHARGE OF PROTECTIVE SUPPLIES
B IN CHARGE OF CHEMICAL AMMUNITION
C SALVAGE MAINTENANCE AND REPAIR CWS MATERIALS AND WEAPONS
D REIMPREGNATION OF PROTECTIVE CLOTHING
1 SERGEANT
1 CORPORAL
4 PRIVATES 1ST CLASS
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CHEMICAL COMPANY LABORATORY
CHEMICAL COMPANY DECONTAMINATING
CHEMICAL COMPANY DEPOT
CHEMICAL COMPANY MAINTENANCE
CHEMICAL COMPANY IMPREGNATING

■ 84. DUTIES OF THE ARMY CHEMICAL OFFICER.—*a*. While the duties and responsibilities of the army chemical officer follow the same general lines as those of corps and division chemical officers, they are much more extensive.

b. The army chemical officer is concerned with the assignment of suitable personnel for the chemical warfare staff sections of corps and divisions. He exercises technical control over personnel through the regular channels. He is responsible for the supply of all protective equipment for the entire army and for the offensive supplies of chemical troops. His intelligence duties are extensive, and he is actively engaged in planning the operations of chemical troops. This is particularly true of large scale projector or cylinder operations.

c. Five chemical service units function under the general supervision of the army chemical officer. These units are maintenance, depot, laboratory, decontaminating, and impregnating companies. The functions of these units are stated in FM 3–15 and 3–25.

Appendix I

LIST OF REFERENCES

FM 1–10, Tactics and Technique of Air Attack.
FM 2–15, Employment of Cavalry.
FM 3–15, Supply and Field Service.
FM 3–20, Employment of Chemical Troops.
FM 5–5, Troops and Operations.
FM 5–15, Field Fortifications.
FM 5–30, Engineer Antimechanized Measures.
FM 6–20, Tactics and Technique.
FM 6–40, Firing.
FM 7–5, Organization and Tactics of Infantry Rifle Battalion.
FM 21–40, Defense Against Chemical Attack.
FM 23–30, Grenades.
FM 23–90, 81-mm Mortar M1.
FM 100–5, Operations.
FM 100–10, Administration.
FM 101–5, The Staff and Combat Orders.
FM 101–10, Organization, Technical and Logistical Data.
TM 3–215, Military Chemistry and Chemical Agents.
TM 3–240, Meteorology.
TM 3–300, Irritant Candles, Tear Pots, Smoke Pots, and Chemical Land Mines.
TM 3–305, Use of Smokes and Lacrimators in Training.
TM 3–315, The Portable Chemical Cylinder.
TM 3–330, Incendiary Bombs.
TM 8–285, Treatment of Casualties from Chemical Agents.
TM 9–315, 75-mm Gun Matériel M1897 and Modifications.
TM 9–320, 75-mm Howitzer Matériel.
TM 9–345, 155-mm Gun Matériel, M1917, M1918 and Modifications.
TM 9–980, Bombs for Aircraft.
TR 1120–75, 4.2-inch Chemical Mortar, M1A1.

Appendix II

SUMMARY OF TACTICAL DOCTRINE OF USE OF CHEMICAL AGENTS—GENERAL

Persistency.—Select the agent which will have lost its effect when your own troops arrive on the target.

Selection of target.—Favor the main attack. Select the target occupied by the greatest number of the enemy or of greatest potential value to him; where delay, confusion, and casualties will cause him the greatest annoyance; where the agent is most effective; where his loss is your gain.

Selection of weapon.—Select the available weapon which will produce the greatest effect upon the enemy for the ammunition and effort expended.

Time of fire.—Deliver chemical agents upon the target at such a time as—

(1) Meteorological conditions are most favorable.
(2) To secure maximum surprise or cause greatest confusion in hostile forces.
(3) To make the greatest use of your own weapons.
(4) To inflict casualties upon and hinder the enemy at his most critical time.
(5) Not to disclose plan of action in time for enemy to make an orderly redisposition of his forces to meet it.

Rate of fire.—Fire nonpersistent casualty agents at the maximum rate for 2 minutes, utilizing the necessary number of weapons to produce the required concentration. The sustained rate of fire is employed in firing persistent agents.

Quantities available.—When sufficient chemical ammunition is not available for all targets, concentrate the required amount upon the most important targets.

Selection of type agent.—Use nonpersistent casualty agents in high concentration in surprise action for immediate casualties. Use persistent casualty agents for neutralization of areas and counterbattery. Use harassing agents with HE in counterbattery and on targets of opportunity. Use scatter type incendiaries on personnel, animals, and combustible material.

General use in offensive.—Nonpersistent casualty agents should be used to assist in the main attack and or secondary attack by causing casualties and confusion in the main line of resistance. Persistent casualty agents may be used to interdict routes of communication, thus preventing free movement of enemy supplies and reserves, to neutralize critical points and terrain features of great importance to the enemy, and for counterbattery fires. Smoke should be used to gain fire superiority, to blind enemy ground observation, antitank and machine-gun emplacements not definitely located, and to cover our own movement.

General use in defensive.—Persistent casualty agents should be used to create chemical barriers in areas where the fires of our infantry and artillery weapons can be placed to delay an advancing enemy and cause him to take cover in the contaminated area. Also, these agents can be used freely in counterbattery fires and upon defiladed routes of approach, assembly areas, and supply points. Nonpersistent casualty agents may be used against positions known to be occupied by personnel. Harassing agents may be used, in conjunction with smoke, against hostile observation posts to force masking and interfere with efficient use of optical instruments. Smoke should be used to deny distant hostile observation and to support counterattacks.

APPENDIX III

DILUTION TABLES, CLOUD GAS ATTACKS

Distance down wind from source

Initial concentration (percent)	100 yards (percent)	200 yards (percent)	300 yards (percent)	400 yards (percent)	500 yards (percent)	600 yards (percent)	700 yards (percent)
	Small shoots, 100 to 400 yards front						
100	75	56	42	31	23	17	13
	Medium shoots, 400 to 800 yards front						
100	85	72	61	52	44	38	32
	Large shoots, 800 to 3,000 yards front						
100	90	81	73	66	60	54	48
	Very large shoots, over 3,000 yards front						
100	95	90	85	82	78	74	70

APPENDIX IV

CHARACTERISTICS OF CHEMICAL WEAPONS AND TRANSPORT

			4.2-inch chemical mortar	Livens projector	75-mm gun	105-mm howitzer	155-mm howitzer	155-mm gun
Rate of fire, rounds per minute.	Rapid		20	Fired but once	6	4	3	3.
	Prolonged		5		3	2	1	1.
Time to emplace.	Day		5 minutes	90 per platoon in 2½ hours	3 minutes.	3 minutes.	5 minutes.	1 to 6 hours.
	Night		10 minutes	90 per platoon in 5 hours				
Rate of movement.	Day	On roads	Trucks 25 mph Hand carts 2½ mph Hand carry 2¼ mph Mechanized 25 mph	Trucks 25 mph Hand carry 5 minutes per 100 yards	23 mph	23 mph	20 mph	6 mph.
		Across country	Trucks limited Hand carts 1½ mph Hand carry 1¼ mph Mechanized 15 mph	Hand carry 6 minutes per 100 yards	8 mph	8 mph	8 mph	4 mph.
	Night	On roads	Trucks (lights) 20 mph Trucks (no lights) 8 mph Hand carts 2 mph Hand carry 1¾ mph Mechanized (lights) 20 mph (No lights) 8 mph	Trucks (lights) 20 mph Trucks (no lights) 8 mph Hand carry 8 minutes per 100 yards	23 mph	23 mph	20 mph	6 mph.
		Across country	Trucks limited Hand carts 1 mph Hand carry ¾ mph Mechanized 5 mph	Hand carry 12 minutes per 100 yards	3 mph	3 mph	3 mph	2 mph.
Capacity of transport.	2½-ton truck		1 complete squad and equipment.	25				
	1½-ton truck			15				
	Man			0.3				

DATA ON CHEMI

Munition	Agents and weight of filling (pounds)	Weight of filled munition complete (pounds)	Approximate time for agent to burn or evaporate at point of release
Grenade, hand, gas, irritant, CN–DM, M6.	CN–DM mixture, ¼ (2 oz. each).	1 1/16	40 sec
Candle, gas, irritant, DM, MI.	DM, 2	9	2 min
Cylinder, chemical, portable, M1A2.	CG, 31.7	54.7 [2]	1 min
Land mine (1-gal. can)	HS, 10.5	13.0	10 days [3]
Shell, chemical, livens projector, MII and MIIA1.	CG, 28	61.5	1 min
Pot, smoke, HC, MI	HC, 12.5	14.3	5–8 min
Shell, 4.2-in. chemical mortar.	WP, 7.56	WP, 25.56	WP, 2–3 min
	HS, 6.5	HS, 24.50	HS, 10 days [3]
	CG, 6.25	CG, 24.25	CG, 1 min
	CNS, 7.07	CNS, 25.07	CNS, 2 hr. (1 hr. summer).
Shell, 81-mm mortar, M57.	WP, 4.1	11.4	1 min
Shell, 75-mm howitzer and 75-mm gun, chemical, Mk. II.	HS, 1.37	11.9 to 13.0 [4]	HS, 1 week [3]
	WP, 1.82		WP, 30 sec
Shell, 75-mm howitzer and 75-mm gun, chemical, M64.	HS, 1.04	HS, 12.79	HS, 1 week [3]
	WP, 1.35	WP, 13.10	WP, 30 sec
Shell, 105-mm howitzer, M60.	HS, 3.17	HS, 33.0	HS, 1 week [3]
	WP, 4.7	WP, 34.4	WP, 1 min
Shell, 155-mm gun, Mk. VIIA1 and M105.	HS, 11.54	91.54	10 days [3]
Shell, 155-mm howitzer, Mk. IIA1 and M104.	HS, 11.54	HS, 91.54	HS, 10 days [3]
	WP, 15.35	WP, 95.35	WP, 2 min
Tank, airplane, chemical spray:	A–20B [6] Inbound / Outbound	A–20B [6] Inbound / Outbound	
M10, nonpressure [5]	HS 352 / 305	HS 420 / 373	HS, 4–6 hr
	M–1 432 / 305	M–1 500 / 373	M–1, 4–6 hr
	FS, 432 / 305	FS, 500 / 373	FS, 5–10 sec [7]
	CNS, 392 / 305	CNS, 460 / 373	CNS, 1 hr
M20, pressure [8]	FS, 800	FS, 1022 [9]	FS
	FM, 696	FM, 918 [9]	FM
	HS, 503	HS, 725 [9]	HS, 6 hr

See footnotes at end of table.

DIX V

CAL MUNITIONS

Effective range of weapon	Marking and color		Chemical efficiency (percent)
35 yd.[1]	CN–DM, Gas, 1 band.	Red	23.5.
None [1]	DM–Gas, 1 band	Red	22.2.
(3)	CG, Gas, 1 band	Green	58.0.
Must be placed	HS, Gas, 2 bands	Green	85.0.
470–1,450 yd	CG–Gas, 1 band	Green	45.5.
(3)	HC, Smoke, 1 band	Yellow	87.4.
600–2,400 yd	WP, Smoke, 1 band	Yellow	WP, 29.6.
	HS, Gas, 2 bands	Green	HS, 26.5.
	CG, Gas, 1 band	Green	CG, 25.7.
	CNS, Gas, 1 band	Red	CNS, 28.2.
300–2,470 yd	WP, Smoke, 1 band	Yellow	36.
75-mm howitzer, 6,000 yd	HS, Gas, 2 bands	Green	10.9 to 14.6.
75-mm gun, 8,000 yd	WP, Smoke, 1 band	Yellow	
75-mm howitzer, 8,100 yd	HS, Gas, 2 bands	Green	HS, 8.1.
75-mm gun, 11,500 yd	WP, Smoke, 1 band	Yellow	WP, 10.3. FS, 11.4.
10,300 yd	HS, Gas, 2 bands	Green	HS, 10.0. WP, 13.7.
	WP, Smoke, 1 band	Yellow	FS, 13.9.
M1, 22,100 yd	HS, Gas, 2 bands	Green	HS, 12.6.
M1918A1, 15,200 yd	WP, Smoke, 1 band	Yellow	WP, 16.1.
10,500 yd.			
Variable depending on airplane radius of action.			A–20B Inbound / Outbound: HS 83.8 / 81.8. M–1 86.4 / 81.8. FS 86.4 / 81.8.
do			FS, 78.2. FM, 75.8. HS, 69.4

APPENDIX V

DATA ON CHEMI

Munition	Agents and weight of filling (pounds)	Weight of filled munition complete (pounds)	Approximate time for agent to burn or evaporate at point of release
Tank, airplane, chemical spray—Con.			
M21 pressure [10]	FS, 480	FS, 621 [11]	FS
	FM, 417	FM, 558 [11]	FM
	HS, 300	HS, 441 [11]	HS, 6 hr
Bomb, chemical:			
30-lb., M1	WP, 12.8	WP, 31.8	WP, 2–3 min. [12]
	HS, 9.48	HS, 28.48	HS, 1 week [3]
30-lb., M46	WP, 27.43	WP, 33.18	WP, 4–5 min. [12]
	HS, 20.33	HS, 26.08	HS, 1 week [3]
100-lb., M47	HS, 74.75	95.45	1 week [3]
Bomb, incendiary 4-lb.: [13]			
Magnesium body AN–M50–A1. AN–M50X–A1.	TH, 5/8	Approximately 4	
Steel body AN–M54. AN–M54X.	TH, 1 5/16	Approximately 4	
100-lb., M47 Gasoline-rubber filled.	SR, CR, LA60, LA100 (Contains about 6 gal. of incendiary oil.)	70	

[1] Effective range variable depending on quantity of agent released, terrain, and meteorological conditions. With grenades, gas agent is thrown laterally 1 foot.

[2] Weight includes 1.5 pounds CO_2.

[3] Variable depending on amount of agent released, terrain, and meteorological conditions.

[4] Weight of filled shell varies due to type of filling and fuze used.

[5] Tank weight, 68 pounds. Tank capacity, 33 gallons (including 1 gallon void).

[6] A–20B equipped with caliber .50 machine guns; also for glide bombing.

[7] Time to discharge tank.

[8] M20 tank capacity, 50 gallons.

[9] Total weight includes:
Tank weight, 189 pounds.
CO_2 cylinder, 31 pounds (12.6 pounds CO_2).
Regulator valve, 2 pounds.

—Continued

CAL MUNITIONS—Continued

Effective range of weapon	Marking and color	Chemical efficiency (percent)
Variable depending on airplane radius of action.		FS, 77.3. FM, 74.7. HS, 68.0.
----do----	WP, Smoke, 1 band Yellow	WP, 40.2.
	HS, Gas, 2 bands Green	HS, 33.2
		WP, 82.6.
		HS, 77.9.
		78.3.
Variable depending on airplane radius of action.	TH 50 A1 or 54 A1 1 band Purple	52.
----do----	Incendiary oil SR, CR, LA60 or LA100 1 band. Purple	42.

[10] M2i tank capacity, 30 gallons.

[11] Total weight includes:
Tank weight, 120 pounds.
CO_2 cylinder, 19 pounds (7.25 pounds CO_2).
Regulator valve, 2 pounds.

[12] Widely variable depending on wind and condition of earth at point of impact.

[13] Four-pound incendiary bombs are assembled into 100-pound and 250-pound cluster adapters, each of which contains, respectively, 34 and 62 bombs, or 500-pound cluster adapters containing 128 bombs each.

APPENDIX VI

LOGISTICAL DATA ON CHEMICAL WARFARE MUNITIONS

Article	Approximate weight (pounds)	Cubic foot displacement	1½-ton truck[1]	1-ton trailer[1]	4-man hand cart[1]	Man[1]
4.2-inch chemical mortar:						
M1A1, complete, boxed, less baseplate and boxed standard	223	6.6	13	9	...	¼
Barrel, M1A1	91	1.5	33	22	1	½
Base plate, M11	150	1.4	20	13	1	½
Standard, M1	53	3.6	32	21	1	1
Shell, boxed (2)	65	1.12	90	60	10	2
Shell, loose	25	.2	117	80	...	2
Cart, hand, loaded, with 4.2-inch chemical mortar, complete	491	39.2	2	.....	1	¼
Cart, hand, loaded, with 10 rounds, complete	479	39.2	2	.....	1	¼
Standard M1, boxed, complete	110	6.4	18	18		½
Livens projector, 8-inch:						
Barrel, loose	110	3.83	28	18	4	1
Baseplate, loose	28	.1	107	71	8	2
Baseplate, boxed (5)	185	.5	80	50	5	.....
Shell, boxed (1)	83	1.5	36	24	3	1
Shell, loose	61	.8	49	32	4	1
Charges, boxed (4)	56	2.2	212	144	...	4
Charges, loose	4	.5	345	234	...	4
Projector, complete with ammunition	203	6.83	15	10	3	⅓
Portable chemical cylinders:						
Empty	22	.2	63	42	4	2
Filled	55	.2	50	33	4	1
Empty (boxed) (2)	77	4.34	54	36	...	½
Irritant candles, DM, M1:						
Loose	9.2	.24	220	150	20	2
Boxed (10)	136	4.06	220	150	20	5
Chemical land mines, land mines	13	.2	200	135	...	2

[1] The quantities given in these columns refer to individual munitions

APPENDIX VII

AMMUNITION REQUIREMENTS

1. CHEMICAL SHELL.

Point targets

Minimum depth in line of fire 200 yards, observed fire

Agent	HS [1 2]				CNS [3 5]	CG [4]
Weapon	75-mm gun or howitzer.	105-mm howitzer.	155-mm gun or howitzer.	*Inches* 4.2 mortar.	*Inches* 4.2 mortar.	*Inches* 4.2 mortar.
Rounds per target.	160	60	30	30	8	90.

Area targets

Minimum depth in direction of fire, 300 yards. Determine the number of squares each 100 by 100 yards, or the number of circles each 200 yards in diameter, in the target and multiply by the following for the weapon and agent used.

Agent	HS [1 2]				CNS [3 5]	CG [4]	
Weapon	75-mm gun or howitzer.	105-mm howitzer.	155-mm gun or howitzer.	*Inches* 4.2 mortar.	*Inches* 4.2 mortar.	*Inches* 4.2 mortar.	Livens projector.
Rounds per square.	80	30	15	15	4	45	15.
Rounds per circle 200 yards diameter.	320	120	60	60	16	180	60.

[1] Do not fire HS below 32° F. Use M–1.
[2] For neutralization. For harassing, use half the quantities indicated.
[3] Rounds per hour.
[4] Fired at maximum rate and not to exceed 2 minutes.
[5] Below 50° F. increase 25 percent.

■ 2. SMOKE.—The smoke ammunition requirements indicated are for average meteorological conditions. The ammunition required will vary with terrain and weather conditions.

a. Rounds per 100 yards per minute for combined screening and casualty effects.

Wind direction	Following, 6 o'clock	Head, 12 o'clock	Flank, 3 or 9 o'clock	Quartering
81-mm mortar	2.5	2	1.0	2
4.2-inch chemical mortar	1.25	1	.5	1
75-mm gun or howitzer	12	10	4	8
105-mm howitzer	9	7	1.5	6
155-mm howitzer	3	2	.5	2

b. Rounds per 100 yards per minute for screening effects only.

Wind direction	Following, 6 o'clock	Head, 12 o'clock	Flank, 3 or 9 o'clock	Quartering
81-mm mortar	1.5	1.5	0.8	1.0
4.2-inch chemical mortar	.7	.7	.4	.5
75-mm gun or howitzer	6	6	3	4
105-mm howitzer	4	4	1.5	3
155-mm howitzer	1.3	1.3	.5	1
HC smoke pots[1]	6	6	3–4	5

[1] For smoke pots, the quantities indicated are the number of pots that must be kept burning. The smoke pots burn an average of 6½ minutes, hence the indicated quantity will screen 100 yards for that period.

c. Procedure.—To obtain the number of rounds required, measure the line to be screened in hundreds of yards. Multiply this length by the quantity shown for the direction of wind given. Multiply this result by the number of minutes the screen is to be maintained plus one minute for the establishment of the screen. For adjustment fire and establishment of the screen approximately three times as much ammunition is required as for maintenance.

■ 3. AIRPLANE MUNITIONS.—*a. Bombs, HS.*

(1) *M1 bombs.*

Per square of area target	21
Per 100 yards of occupied road target	5
Per 100 yards of road for interdiction	10

(2) *M46 bombs.*

Per square of target area	10
Per 100 yards of occupied road target	5
Per 100 yards of road for interdiction	10

(3) *M47 bombs.*—Used for large area contamination.

b. HS spray attack.—See FM 1–10.

c. Smoke screen, airplane spray.—See FM 1–10.

■ 4. LAND MINES, HS FILLED.

Purpose	Mines required
Barriers	Barriers should have a minimum depth of 100 yards, greater when the situation permits. Twenty-four mines per square should be used when the depth is greater than 200 yards and 36 mines per square when the depth is less than 200 yards.
In roads	One line of mines on each side of road with mines staggered at 10-yard intervals along each side.
Demolitions	Mines placed in lines 5 yards apart at 5-yard intervals along each line. The approaches to the demolition should be contaminated using 20 mines per square.

■ 5. CLOUD ATTACKS.—*a. Rules* (fig. 22).

(1) Fire one cylinder per yard of front for the first 1,000 yards in range, add one-half cylinder per yard of front for each additional thousand yards in range. Maximum effective range 7,500 yards.

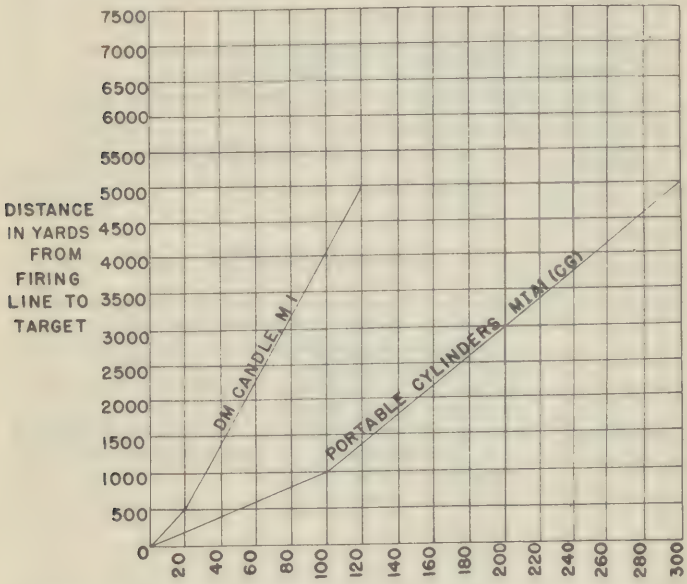


FIGURE 22.—Number of munitions per 100 yards of firing front.

(2) One-fifth candle per yard of front is required for targets 500 yards away. Add one-fifth candle per yard of front for each additional thousand yards in range. Maximum effective range 5,000 yards.

b. Rule (fig. 23).—A chemical cloud should be generated on a front as wide as the target to be covered plus 0.2 of the

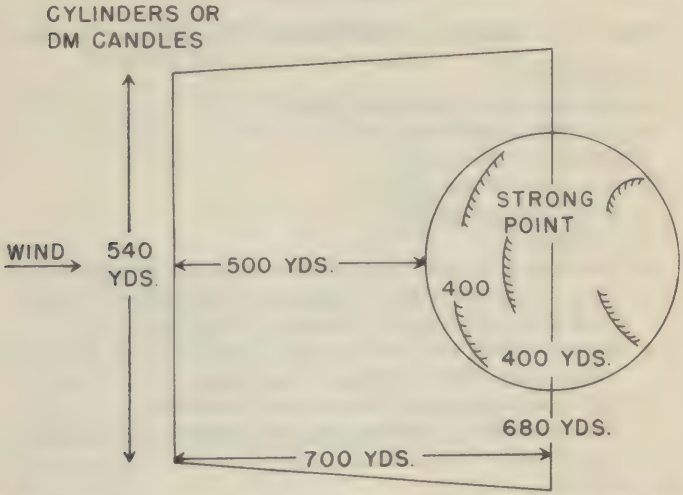


FIGURE 23.—Use of chemical clouds against definite targets (average conditions).

distance to the target; *but must be at least one-half as wide as the distance from the firing line to the target.*

APPENDIX VIII

FORM FOR CHEMICAL ESTIMATE OF THE SITUATION

1. SITUATION.
   - *a.* Disposition of opposing forces.
   - *b.* Plan of commander.
   - *c.* Mission of chemicals.
   - *d.* Troops to be employed.
   - *e.* Weather conditions.
2. WEAPONS.
   - *a.* Kinds and number and location of each available.
   - *b.* Consideration of the weather and elimination of weapons found unsuitable because of weather.
   - *c.* Consideration of terrain and elimination of weapons found unsuitable because of terrain.
   - *d.* Time available until weapons are required.
   - *e.* Time at which weapons may be available for action.
   - *f.* Summary of available weapons.
3. AGENTS.
   - *a.* Kinds available.
   - *b.* Consideration of weather and elimination of agents unsuitable because of weather.
   - *c.* Character of action and elimination of agents unsuitable because of character of action.
   - *d.* Amount and location of available agents.
   - *e.* Summary of agents.
4. TARGETS.
   - *a.* Enemy troops.
   - *b.* Enemy establishments.
   - *c.* Gas targets.
   - *d.* Smoke targets.
   - *e.* Weather and terrain conditions.
5. PLANS.
   - *a.* Plans for preparation fire.
   - *b.* Plans for supporting fire.
   - *c.* Analysis of plans.
6. DECISION.

APPENDIX IX

FORM FOR CHEMICAL ANNEX
(Normally used only in stabilized situations)

ANNEX NO. — TO FIELD ORDERS NO. —, — DIVISION (CORPS) (ARMY) CHEMICAL WARFARE

Title
Place
Date and hour

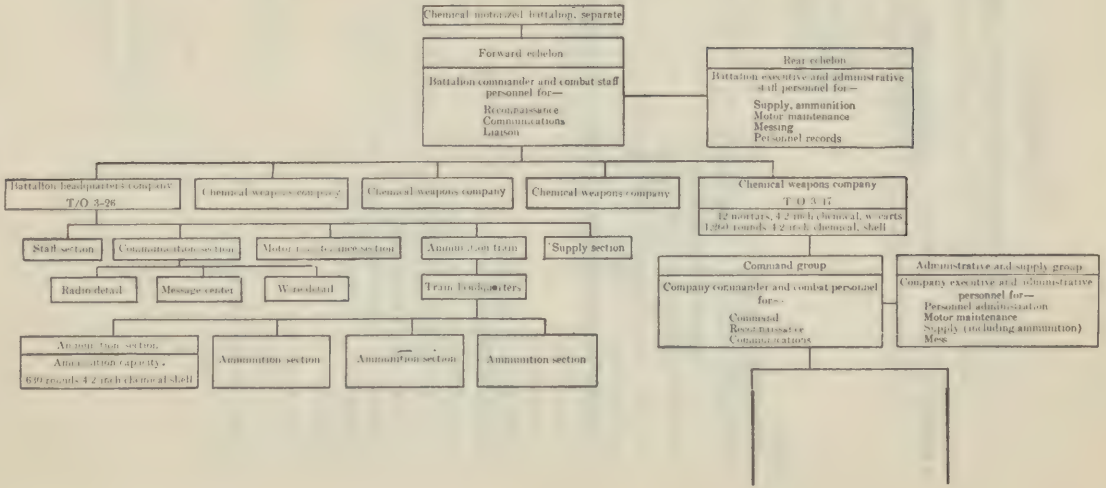
Maps

1. INFORMATION.
   a. Hostile chemical operations.
      (1) Known operations.
      (2) Expected operations.
   b. Our own chemical operations.
   c. Weather.
2. PLANS FOR CHEMICAL OPERATIONS.
   a. Artillery.
   b. Air force.
   c. Chemical troops.
3. PROTECTION.
   a. Individual protection.
   b. Collective protection.
   c. Tactical protection.
   d. Special operations.
4. SUPPLY AND EVACUATION.
   a. Supply.
   b. Evacuation.
   c. Salvage.
5. MISCELLANEOUS.

APPENDIX X

ORGANIZATION OF CHEMICAL MOTORIZED BATTALION, SEPARATE

(T/O 3-25)



SUMMARY

Strength: See T/O 3-25.

Fire power: 4.2-inch chemical mortar 48.
Other weapons, see T/O 3-25 or T/BA No. 3

Vehicles: See T/O 3-25 or T/BA No. 3.

AMMUNITION CAPACITY

Each company:	
In (2) ammunition carts	120 round.
In (24) squad trucks and trailers	240 do.
In (4) company trucks and trailers	420 do.
Total, 4 companies	
Each ammunition section	630 5,040
Ammunition train	2,520
Total within battalion	7,560

INDEX

CHEMICAL WARFARE SERVICE FIELD MANUAL

TACTICS OF CHEMICAL WARFARE

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON 25, D. C., 13 March 1944.

FM 3–5, 20 July 1942, is changed as follows:

Symbols for war gases referred to in this manual are changed as follows. They will be corrected whenever they occur in the text.

War gas	*Symbol* Old	New
Mustard gas	HS	H
Lewisite	M–1	L

[A. G. 300.7 (10 Nov 43).] (C 1, 13 Mar 44.)

■ 6. PERSISTENCY.

* * * * *

b. (Superseded.) *Persistent* agents are those which remain effective in the open for more than 10 minutes at the point of dispersion.

(1) Moderately persistent agents are those which remain effective in the open from 10 minutes to 12 hours at the point of dispersion.

(2) Highly persistent agents are those which remain effective in the open longer than 12 hours at the point of dispersion.

[A. G. 300.7 (10 Nov 43).] (C 1, 13 Mar 44.)

Figure 2 is rescinded and the following is substituted therefor:

*These changes are printed as a pamphlet to conserve paper and printing and to expedite delivery to the field.

575804°—44

SYMBOL	AGENT	TACTICAL CLASSIFICATION					PERSISTENCY CLASSIFICATIONS			PHYSIOLOGICAL CLASSIFICATIONS				
		Casualty	Harassing	Obscuring	INCENDIARY		Non-persistent	Moderately persistent	Highly persistent	Lung irritant	Vesicant	Systemic poison	IRRITANT	
					Scatter	Intensive							Lacrimator	Sternutator
H	Mustard gas									D	D			
HN	Nitrogen Mustard gases									D	D			
L	Lewisite									D	D			
ED	Ethyldichlorarsine									D	D			I
CG	Phosgene									ID				
AC	Hydrocyanic Acid											I		
PS	Chlorpicrin									D			I	D
CC	Cyanogen Chloride											I	I	
SA	Arsine											I		
CNS	CN Solution												I	
DM	Diphenylaminechlorarsine (adamsite)													I
FS	Sulfur Trioxide Solution													
HC	Hexachlorethane Mixture													
WP	White Phosphorus													
TH	Thermit													
IM	Incendiary Oil													
NP	Incendiary Oil													

Primary Classification

Additional Classification

I—Immediate Action
D—Delayed Action
ID—Immediate to Delayed

NOTE: Additional agents used primarily in training are listed in TM 3-305.

FIGURE 2.--Classification of typical chemical agents.

■ 8. METHODS OF DISSEMINATION.

* * * * *

a. Static weapons. Chemical weapons that * * * point of emplacement. The irritant gas candle is included in the first class; the chemical land mine is the principal weapon of the second class.

* * * * *

c. Projectiles: medium and long range.– Infantry and chemical mortar shells provide means of projecting gas and screening smoke to ranges up to about 4,400 yards. Chemical shells are * * * about 22,000 yards.

* * * * *

[A. G. 300.7 (10 Nov 43).] (C 1, 13 Mar 44.)

■ 9. WIND.—*a. Effect upon nonperistent agents.*

* * * * *

(2) *Velocity.*—With cloud gas * * * to be variable. When the agent is delivered by artillery, mortars, or aircraft, this lower limit of wind velocity need not be considered unless the target is very close to our own lines. Wind velocity should * * * escape its effect. The upper limit of 12 miles per hour applies to artillery, mortar, and aircraft operations.

b. Effect upon persistent agents.– With persistent agents * * * to friendly troops. When **the direction of the prevailing wind is unfavorable**, persistent agents should not be used in large quantities on areas closer than 600 yards to any position friendly troops are expected to occupy. **If the direction of the prevailing wind is favorable, the 600-yard limitation may be reduced to 400 yards.**

[A. G. 300.7 (10 Nov 43).] (C 1, 13 Mar 44.)

■ 13. PRECIPITATION.—*a. Effect upon nonpersistent agents.*

* * * * *

b. Effect upon persistent agents.—Heavy rains in * * * of mustard gas. **The nitrogen mustards are slowly hydrolyzed by water, and the end products of hydrolysis are not toxic.** Lewisite is readily hydrolyzed but forms a toxic vesicant solid.

* * * * *

[A. G. 300.7 (10 Nov 43).] (C 1, 13 Mar 44.)

■ 20. CHEMICAL AGENTS IN STABILIZED OPERATIONS.—*a. Nonpersistent casualty agents.*—Shell attacks are made on areas

occupied by enemy troops to precede an attack by our forces, to forestall an attack, or to weaken his forces.

* * * * *

[A. G. 300.7 (10 Nov 43).] (C 1, 13 Mar 44.)

■ 23. ORGANIZATION.—Chemical troops (weapons) are organized and equipped for the purpose of firing chemical agents and high explosive shell. Their organization is such that they may be employed as battalions, companies, or platoons, with the smaller elements either removed from the control of the larger units or operating directly under them. The size and * * * to be used.

a. Chemical battalion motorized.—The battalion is the basic combat chemical unit. Its organization includes a headquarters, headquarters detachment, and four weapon companies. The chemical fire power is 48 chemical mortars. Other chemical weapons and munitions presently standardized and used by chemical troops are the land mine, irritant candle, and smoke pot. (See T/O & E 3–25 and Appendix X for details of organization of this unit.)

b. (Superseded.) *Headquarters detachment.*—The headquarters detachment consists of detachment headquarters, headquarters section, maintenance section, and ammunition and supply section. It is a function of the headquarters section to furnish personnel for staff purposes and for communication between the battalion and the unit to which attached and with the companies. (See T/O & E 3–26 for details of organization.)

c. (Superseded.) *Weapons company, chemical battalion, motorized.*—This unit consists of the company headquarters and three platoons. The company is organized and equipped to act independently of battalion control when required. When a company is detached from its battalion and attached to a task force or combat team, a part of the ammunition section from the headquarters detachment is attached to the weapons company. The fire power of the chemical company is 12 mortars. The platoon is the basic fire unit and is capable of independent tactical missions but is dependent on the company for supply. As indicated in *a* above, the company is prepared to employ other chemical weapons and munitions. Personnel and weapons

are transported by organic trucks. (See T/O & E 3–27 for details of organization.)

[A. G. 300.7 (10 Nov 43).] (C1, 13 Mar 44.)

■ 24. CHEMICAL ARMAMENT.—The military characteristics * * * described in FM 3–20. For description and function of this matériel see the Technical Manual reference under each weapon.

a. 4.2-inch chemical mortar (fig. 10).—This mortar is * * * types of warfare. Mortar shell fillings include nonpersistent casualty **gases, blister gases,** harassing gases, **high explosives,** and smoke. **(See TM 3–320.)**

* * * * *

c. Rescinded.

d. Rescinded.

[A. G. 300.7 (10 Nov 43).] (C1, 13 Mar 44.)

Figure 11. Rescinded.

[A. G. 300.7 (10 Nov 43).] (C1, 13 Mar 44.)

Figure 12. Rescinded.

[A. G. 300.7 (10 Nov 43).] (C1, 13 Mar 44.)

■ 25. ASSIGNMENT AND CONTROL.

* * * * *

b. Control.—The control of * * * by higher commands. For smoke operations, they **may be** employed **as** platoons under infantry regiment, or **infantry** battalion control. For mortar operations they may be employed either in small or large units.

[A. G. 300.7 (10 Nov 43).] (C1, 13 Mar 44.)

■ 26. CHARACTERISTICS AND POWERS.

* * * * *

a. Nonpersistent casualty gases.

* * * * *

(1) *Chemical mortar operations.*—A chemical battalion, using its 48 mortars, can effectively **cover** an area of **24** squares (100 by 100 yards each) of phosgene-filled shell per mortar **when 40 rounds or more of nonpersistent casualty gas shell per**

mortar are available. The cloud is * * * such an attack. When the situation does not permit bringing up additional ammunition for this type of operation, the battalion can **cover** a smaller target such as an infantry company defense area. **When insufficient ammunition is available, nonpersistent casualty gas shell should not be wasted by firing upon an area too large to produce an effective concentration. It is preferable to select a smaller target where a sufficient concentration can be obtained with the available shell.**

(2) Rescinded.
(3) Rescinded.

b. Persistent casualty agents.

* * * * *

(1) *Chemical mortar operations.*—The creation of chemical barriers requires large quantities of ammunition. A chemical company, using its 12 mortars, can contaminate about **40** squares in 1 hour. This degree of contamination will be approximately the same as that attained with **18** chemical land mines per square. For the purpose of comparison, a battalion of 105-mm howitzers can similarly contaminate about **5** squares per hour.

* * * * *

c. Smoke operations.—The chemical mortar * * * the fire unit. Using **its four mortars**, a chemical platoon can screen about **800** yards of front, assuming the most unfavorable wind direction.

[A. G. 300.7 (10 Nov. 43).] **(C1, 13 Mar 44.)**

■ 27. In the Offensive.—The mission of * * * of the attack. This assistance is provided by the use of **gas, smoke, or high explosives.**

a. Nonpersistent agents.

* * * * *

(4) Rescinded.

* * * * *

d. Control.

* * * * *

(2) (Superseded.) Units may be held under centralized control for firing concentrations of gas or reinforcing preparatory fires; upon conclusion of these missions they are generally released and attached to subordinate units.

* * * * *

e. (Added.) *High explosives.*—(1) In the preparation period high explosive shell may be used in massed fires to neutralize organized positions. It may also be used effectively against specific targets such as machine guns, pill boxes, concrete shelters, bunkers, command posts, troop concentrations, and like targets within range.

(2) As the attack progresses, high explosive shell may be used in conjunction with white phosphorus in smoke screens or in concentrations for casualty effects and demoralization of the enemy.

[A. G. 300.7 (10 Nov 43).] (C1, 13 Mar 44.)

■ 28. In the Defensive.

* * * * *

a. Nonpersistent agents.—(1) Chemical troops using the chemical mortar are employed in the defensive to fire nonpersistent agents on targets of opportunity, such as troops forming for the attack, or on supports and reserves.

(2) In situations where the enemy remains in position in close contact for some time, chemical troops using chemical mortars should be employed to fire nonpersistent gas concentrations on all areas within range known to be heavily occupied by the enemy.

* * * * *

e. (Added.) *High explosives.*—(1) High explosive shell may be used alone or in conjunction with fires of casualty gases or white phosphorus against troops forming for the attack or in support or reserve.

(2) In counterattacks high explosive shell may be used in conjunction with smoke to neutralize enemy fire.

(3) High explosive may be used to fire on areas which cannot be effectively covered by other weapons of supported troops. Normal barrages may be assigned chemical troops and also emergency barrages may be prescribed as secondary missions.

Mortar fires must be coordinated and fit into the general fire plan of all weapons.

[A. G. 300.7 (10 Nov 43).] (C1, 13 Mar 44.)

■ 29. In Stabilized Situations.

* * * * *

a. Nonpersistent agents.—(1) The projection of nonpersistent gas by chemical troops in stabilized situations is accomplished with the chemical mortar.

(2) Suitable targets for * * * weakening immediate opposition. Also, they may be made at the proper time to forestall an enemy attack.

(3) Rescinded.

* * * * *

d. Control.—In stabilized operations, * * * in local counterattacks. **Chemical mortar units may be assigned missions in support of combat outpost and other security detachments. On retirement these units withdraw to previously assigned positions for organized fires. (See par. 28*e*.)**

e. (Added.) *High explosives.*—In stabilized situations high explosive shell may be used to neutralize areas and destroy wire entanglements and other light obstacles.

[A. G. 300. 7 (10 Nov 43).] (C1, 13 Mar 44.)

■ 59. Airplanes and Chemical Armament.

* * * * *

b. Chemical armament.

* * * * *

(1) Rescinded.

(2) Rescinded.

(3) *100-pound chemical* **bombs** M47. ***M47A1, and M47A2.***—**These are** thin-case bombs. **The M47 bomb is filled with incendiary oils IM or NP. The M47A1 and M47A2 bombs may be filled with incendiary oils, mustard gas, or white phosphorus. (See TM 9–1980.)**

(4) ***2-pound and** 4-pound incendiary bombs.* These are intensive * * * intense incendiary action. (**See TM 9–1980.**)

* * * * *

(6) (Added.) *M70 chemical bomb.*—This bomb weighs approximately 115 pounds and has a heavier case than the M47 type bombs. It is filled with mustard gas. (See TM 9–1980.)

(7) (Added.) *6-pound incendiary bombs.*—These bombs are scatter type and operate by ejecting IM or NP out the tail after impact. They are grouped in clusters for loading into airplane bomb racks.

[A. G. 300.7 (10 Nov 43).] (C 1, 13 Mar 44.)

■ 60. AGENTS EMPLOYED.—*a. Nonpersistent casualty agents.*

* * * * *

c. Persistent casualty agents.—(1) **Blister gases,** being **liquids,** are suitable for use in spray tanks and bombs. Mustard **gas (H),** lewisite **(L),** or a mixture of these **gases** may be used, the selection being somewhat dependent upon temperature, the rapidity of physiological action, and the degree of persistence desired. When sprayed, these * * * to neutralize terrain.

* * * * *

d. Smoke agents.

* * * * *

(2) White phosphorus (WP) is * * * of the bomb. Smoke is produced from the WP fragments of the **M47A1** bomb for about 6 minutes. The duration of * * * point of impact.

e. Incendiary agents.—Incendiary bombs are * * * woods, grass, crops, etc. Small magnesium and **oil** bombs are employed against metropolitan areas or where little accuracy in bombing is required.

[A. G. 300.7 (10 Nov 43).] (C 1, 13 Mar 44.)

APPENDIX IV (SUPERSEDED)

CHARACTERISTICS OF CHEMICAL WEAPONS AND TRANSPORT

			4.2-inch chemical mortar
Rate of fire, rounds per minute		Rapid	20
		Prolonged	5
Time to emplace		Day	5 minutes
		Night	10 minutes
Rate of movement	Day	On roads	Trucks 25 mph
			Hand carts 2½ mph
			Hand carry 2¼ mph
			Mechanized 25 mph
		Across country	Trucks limited
			Hand carts 1½ mph
			Hand carry ¾ mph
			Mechanized 15 mph
	Night	On roads	Trucks (lights) 23 mph
			Trucks (no lights) 8 mph
			Hand carts 2 mph
			Hand carry 1¾ mph
			Mechanized (lights) 23 mph
			(No lights) 8 mph
		Across country	Trucks limited
			Hand carts 1 mph
			Hand carry ½ mph
			Mechanized .5 mph
Capacity of transport		Two trucks ¼-ton with trailers	1 complete squad 1 mortar, and 48 rounds 4.2-inch shell

[A. G. 300.7 (10 Nov 43).] (C 1, 13 Mar 44.)

APPENDIX V (SUPERSEDED)

DATA ON CHEMICAL MUNITIONS

Munition	Agent and approximate weight of filling (pounds)	Approximate weight of munition filled (pounds)	Approximate time for agent to burn or evaporate at point of release	Effective range of weapon [1]	Marking and color	Chemical efficiency (percent)
Grenade, hand, gas, irritant, CN–DM, M6.	CN–DM mixture 0.62.	1 1/16	25 to 40 sec	35 yd.[2]	CN–DM gas, 1 band, red.	58.5.
Grenade, smoke, white, AN–M8.	HC 1 3/16	1 3/8	2 to 2½ min	35 yd	HC smoke, 1 band, yellow.	86.4.
Grenade, smoke, bursting type, M15.	WP .95	1 15/16	50 to 60 sec	35 yd	WP smoke, 1 band, yellow.	49.
Grenade, incendiary, AN–M14.	TH 1 5/8	2	30 to 35 sec		TH, incendiary, 1 band, purple.	81.2.
Grenade, smoke, red, AN–M3.	Colored smoke 1 1/16.	2	110 to 150 sec		Smoke, red, 1 band, yellow.	34.4.
Grenade, frangible M1.	Sulfur trioxide chlorsulfonic acid mixture 2.	2 5/8	Vaporizes	25 yd	None	76.2.
	IM 1	1 3/8	2 min	25 yd.	None	72.7.
	NP 1	1 3/8	2 min	25 yd	None	72.7.
Grenade, smoke, colored, M16.	Blue smoke ½	1¼	110 to 150 sec		Smoke (color) 1 band, yellow.	40.
	Green smoke 5/8					50.
	Orange smoke 5/8					50.
	Red smoke 1 1/16.					55.
	Violet smoke 1 1/16.					55.
	Yellow smoke 1 1/8.					55.
Candle, gas irritant, DM, M2.	DM 2	9	3 to 5 min	None [3]	DM gas, 1 band, red.	22.2.

See footnotes at end of table.

DATA ON CHEMICAL MUNITIONS—Continued

Munition	Agent and approximate weight of filling (pounds)	Approximate weight of munition filled (pounds)	Approximate time for agent to burn or evaporate at point of release	Effective range of weapon [1]	Marking and color	Chemical efficiency (percent)
Land mine (1-gal can).	H 10	12.5	10 days [3]	Must be placed	H, gas, 2 bands, green.	80.0.
Pot, smoke, HC, M1.	HC 10.75	12.55	5 to 8 min	Must be placed	HC, smoke, 1 band, yellow.	85.7.
Pot, smoke, floating, M4A1.	HC 27	39	10 to 15 min		HC, smoke, 1 band, yellow.	69.2.
Shell, 4.2-inch chemical mortar, M2.	WP 7.5	WP 25.50	WP 2 to 3 min	600 to 3200 yd [4] (with M5A1 propellant). 600 to 4400 yd [4] (with M6 propellant).	WP, smoke, 1 band, yellow.	WP 29.4.
	H 6.5	H 24.50	H 10 days [3]		H, gas, 2 bands, green.	H 26.5.
	CG 6.25	CG 24.25	CG 1 min		CG, gas, 1 band, green.	CG 25.7.
	CNS 7.0	CNS 25.00	CNS 1 to 2 hr		CNS, gas, 1 band, red.	CNS 28.0.
	FS 7.5	FS 25.5	FS		FS, smoke, 1 band, yellow.	FS 29.4.
	FM 7.5	FM 25.5	FM		FM, smoke, 1 band, yellow.	FM 29.4.
	L 7.5	L 25.5	L 10 days [3]		L, gas, 2 bands, green.	L 29.4.
Shell, 4.2-inch chemical mortar, M3.	TNT 8.5	TNT 25.5	TNT		M3 TNT	TNT 33.3.
Shell, 4.2-inch chemical mortar, E53.	TNT 6.0	TNT 32.0	TNT	585 to 3,480 yd [4] (with E5 propellant).	E53 TNT	TNT 18.7.
Shell, 81-mm mortar, M57.	WP 4.1	11.4	WP 1 min		WP, smoke, 1 band, yellow.	WP 36.
	FS 4.59	11.86	FS	300 to 2,470 yd	FS, smoke, 1 band, yellow.	FS 38.7.
	H 3.15	10.41	H 10 days [3]		H, gas, 2 bands, green.	H 30.3.

Shell, chemical Mk. II; 75-mm gun.	H 1.33	12.31 [5]	H 1 week [3]		H, gas, 2 bands, green.	H 10.8.
	WP 1.81	12.77 [5]	WP 30 sec	7,710 yd	WP, smoke, 1 band, yellow.	WP 14.2.
	FS 1.9	12.86 [5]	FS		FS, smoke, 1 band, yellow.	FS 14.7.
Shell, chemical, M64; 75-mm howitzer.	H 1.04	H 14.94	H 1 week [3]		H, gas, 2 bands, green.	H 7.0.
	WP 1.34	WP 15.25	WP 30 sec	8,170 yd	WP, smoke, 1 band, yellow.	WP 8.8.
	FS 1.51	FS 15.41	FS		FS, smoke, 1 band, yellow.	FS 9.8.
Shell, chemical, M60; 105-mm howitzer.	H 3.17	H 33.42	H 1 week [3]	10,330 yd	H, gas, 2 bands, green.	H 9.5.
	WP 4.10	WP 34.35	WP 1 min		WP, smoke, 1 band, yellow.	WP 11.9.
	FS 4.61	FS 34.86	FS		FS, smoke, 1 band, yellow.	FS 13.2.
Shell, chemical, M84, 105-mm howitzer.	HC 5.45	32.86		10,330 yd	HC, smoke, 1 band, yellow.	16.5.
Shell, chemical, M116B1; 155-mm howitzer.	HC 19.66	94.94		13,855 yd	M116B1, HC, smoke, 1 band, yellow.	20.7.
Shell, chemical, Mk. VIIA1 and M104; 155-mm gun.	H 11.40 (Mk. VIIA1).	L 94.88			H, gas, 2 bands, green.	H 12.0 (Mk. VIIA1).
	H 11.70 (M104)	H 94.42	H 10 days [3]	21,845 yd	H, gas, 2 bands, green.	H 12.4 (M104).
	WP 14.80 (Mk. VIIA1).	WP 98.28			WP, smoke, 1 band, yellow.	WP 15.1 (Mk. VIIA1).
	WP 15.60 (M104)	WP 98.42	WP 2 min		WP, smoke, 1 band, yellow.	WP 15.9 (M104).
Shell, chemical, Mk. IIA1 and M105 155-mm howitzer.	H 11.40 (Mk. IIA1).	H 94.55	H 10 days [3]		H, gas, 2 bands, green.	H 12.1 (Mk. IIA1).
	H 11.70 (M105)	H 94.02		13,855 yd		H 12.4 (M105).
	WP 14.80 (Mk. IIA1).	WP 97.95	WP 2 min		WP, smoke, 1 band, yellow.	WP 15.1 (Mk. IIA1).
	WP 15.60 (M105)	WP 97.92				WP 15.9 (M105).
Tank, airplane chemical spray.	A–20B [6] Out-board	A–20B [6] Out-board				A20B Out-board

See footnotes at end of table.

DATA ON CHEMICAL MUNITIONS—Continued

Munition	Agent and approximate weight of filling (pounds)		Approximate weight of munition filled (pounds)		Approximate time for agent to burn or evaporate at point of release	Effective range of weapon [1]	Marking and color	Chemical efficiency (percent)	
	Inboard	Outboard	Inboard	Outboard				Inboard	Outboard
M10, Nonpressure [7]	H 352	305	H 420	373	H, 4 to 6 hr	Variable depending on airplane radius of action.		H 83.8	81.8
	L 432	305	L 500	373	L, 4 to 6 hr			L 86.4	81.8
	FS 432	305	FS 500	373	FS, 5 to 10 sec. [8]			FS 86.4	81.8
	CNS 392	305	CNS 460	373	CNS, 1 hr			CNS 85.2	81.7
	FM 429	300	FM 497	368	FM			FM 86.3	81.5
M20, Pressure [9]	H 564		H 786 [10]		H, 4 to 6 hr	Variable depending on airplane radius of action.		H 71.8.	
	L 787		L 1009 [10]		L, 4 to 6 hr			L 78.0	
	FS 793		FS 1015 [10]		FS			FS 78.1.	
	CNS 626		CNS 848 [10]		CNS, 1 hr			CNS 73.8.	
	FM 715		FM 937		FM			FM 76.3.	
M21, Pressure [11]	H 339		H 480		H, 4 to 6 hr	Variable depending on airplane radius of action.		H 70.6.	
	L 471		L 612 [12]		L, 4 to 6 hr			L 76.9.	
	FS 475		FS 616 [12]		FS			FS 77.1.	
	CNS 376		CNS 517 [12]		CNS, 1 hr			CNS 70.8.	
	FM 429		FM 570		FM			FM 75.3.	
Bomb, chemical:									
100-lb, M47	IM 41 / NP 41		61			Variable depending on airplane radius of action.	Incendiary, oil, 1 band, purple.	67.2.	
100-lb, M47A1	IM 41 / NP 41		61				Incendiary, oil, 1 band, purple.	67.2.	
	WP 100		120		4 to 5 min. [13]		do	83.3	
100-lb, M47A2	H 71		102		H 1 week [3]		H gas, 2 bands, green.	69.6.	
M70	H 58		116		H 1 week [3]		H gas, 2 bands, green.	50.	

Bomb, incendiary, 4-lb:[14]						
Magnesium body:						
AN-M50-A1.	TH 0.6	4		Variable depending on airplane radius of action.	TH Number of bomb, 1 band, purple.	52.
AN-M50X-A1.	TH 0.46					
AN-M50X-A2.	TH 0.53					
Steel body:						
AN-M54 AN-M54X.	TH 1.43					
AN-M54X-A1.	TH 0.82					
Bomb, incendiary, 2-lb:[15]						
AN-M52	TH 0.46	2		Variable depending on airplane radius of action.	TH, AN-M52, 1 band, purple.	23.0.
AN-M52X	TH ¼	2			TH, AN-M52X, 1 band, purple.	12.5.
Bomb, incendiary oil, 6-lb AN-M69.[16]	IM 3 or NP 3		6	Variable depending on airplane radius of action.	IM or NP, 69, 1 band, purple.	50.
Incendiary, safe destroying, M1.	TH 30		39		Incendiary, safe destroying, TH.	76.8.
Incendiary, pocket, M1.	NP 28		42	Must be placed		67.

See footnotes at end of table.

DATA ON CHEMICAL MUNITIONS—Continued

Munition	Agent and approximate weight of filling (pounds)		Approximate weight of munition filled (pounds)		[1]Approximate time for agent to burn or evaporate at point of release	Effective range of weapon [1]	Marking and color	Chemical efficiency (percent)
	Inboard	Outboard	Inboard	Outboard				
Fire starter, M1	IM–NP .1			.15	4 to 6 min	Must be placed		67.
Flame thrower	NP 36		68			40 to 50 yd		52.9.

[1] Effective range of artillery is given as 85 percent of maximum range.

[2] Effective range variable depending on quantity of agent released, terrain, and meteorological conditions. With grenades, gas agent is thrown laterally 1 foot.

[3] Variable depending on amount of agent released, terrain, and meteorological conditions.

[4] No attempt will be made to exceed maximum firing table ranges specified for the various shell and propellants.

[5] Weight of filled shell varies due to type of fuze used.

[6] A–20B equipped with caliber .50 machine guns; also for glide bombing.

[7] Tank weight, 68 pounds. Tank capacity, 33 gallons (including 1 gallon void).

[8] Time to discharge tank.

[9] M20 tank capacity, 50 gallons.

[10] Total weight includes: Tank weight, 189 pounds. CO_2 cylinder, 31 pounds (12.6 pounds CO_2). Regulator valve, 2 pounds.

[11] M21 tank capacity, 30 gallons.

[12] Total weight includes:
Tank weight, 120 pounds.
CO_2 cylinder, 19 pounds (7.25 pounds CO_2).
Regulator valve, 2 pounds.

[13] Widely variable depending on wind and condition of earth at point of impact.

[14] Four-pound incendiary bombs are assembled into 100-pound cluster adapters each of which contains 34 bombs, or 500-pound cluster adapters containing 128 bombs each.

[15] Two-pound incendiary bombs are assembled into 100-pound and 500-pound cluster adapters each of which contains respectively 51 and 192 bombs.

[16] Six-pound incendiary bombs are assembled into 100-pound and 500-pound cluster adapters each of which contains respectively 14 and 60 bombs.

[A. G. 300.7 (10 Nov 43).] (C 1, 13 Mar 44.)

Appendix VI (Superseded)

LOGISTICAL DATA ON CHEMICAL WARFARE MUNITIONS

Article	Approximate weight (pounds)	Cubic foot displacement	1½-ton truck*	1-ton trailer*	4-man hand cart*	Man*
4.2-inch chemical mortar:						
M1A1, complete, boxed, less baseplate and boxed standard	223	6.8	13	9	------	¼
Barrel, M1A1	91	1.6	33	22	1	½
Baseplate, M11	150	5.1	20	13	1	½
Standard, M1	53	3.0	32	21	1	1
Shell, boxed (2)	65	1.12	90	60	10	2
Shell, loose	25	.2	117	80	------	2
Cart, hand, loaded, with 4.2-inch chemical mortar, complete	491	39.2	2	------	1	¼
Cart, hand, loaded, with 10 rounds, complete	479	39.2	2	------	1	¼
Standard M1, boxed, complete	110	6.4	18	18	------	½
Irritant candles, DM, M2:						
Loose	9.2	.24	220	150	20	2
Boxed (10)	136	4.06	220	150	20	5
Chemical land mines, land mines	13	.2	200	135	------	2
Grenades:						
CN-DM, irritant gas, M6, (boxed) (25)	50	1.6	1,500	1,000	------	25
Colored smoke, M16 (boxed) (25)	55	1.6	1,375	925	------	25
Smoke, AN-M8 (boxed) (25)	60	1.6	1,250	1,000	------	25
Incendiary, AN-M14 (boxed) (25)	75	1.6	1,000	650	------	25
Smoke, M15 (boxed) (25)	75	1.6	1,000	650	------	25
Smoke, red, AN-M3 (boxed) (25)	83	2.5	900	600	------	25
Frangible, (FS), M1 (boxed) (25)	110	3.9	648	432	------	24
Frangible, (AC, IM, NP), M1 (boxed) (25)	80	3.9	888	600	------	24

*The quantities given in these columns refer to individual munitions.

[A.G. 300.7 (10Nov 43).] (C 1, 13 Mar 44.)

APPENDIX VII

AMMUNITION REQUIREMENTS

■ 1. CHEMICAL SHELL (Superseded).

Gas	Mustard gas (H) and lewisite (L) [1] [2]				Chloracetophenone solution CNS [3] [4]	Phosgene CG [5]
Weapon	75-mm gun and howitzer.	105-mm howitzer.	155-mm gun and howitzer.	4.2-inch chemical mortar.	4.2-inch chemical mortar.	4.2-inch chemical mortar.
Rounds per square 100 x 100 yards (area target)	270	116	32	56	4	80
Rounds per circle [6] 200 yards diameter (area target)	1,080	464	128	224	16	320

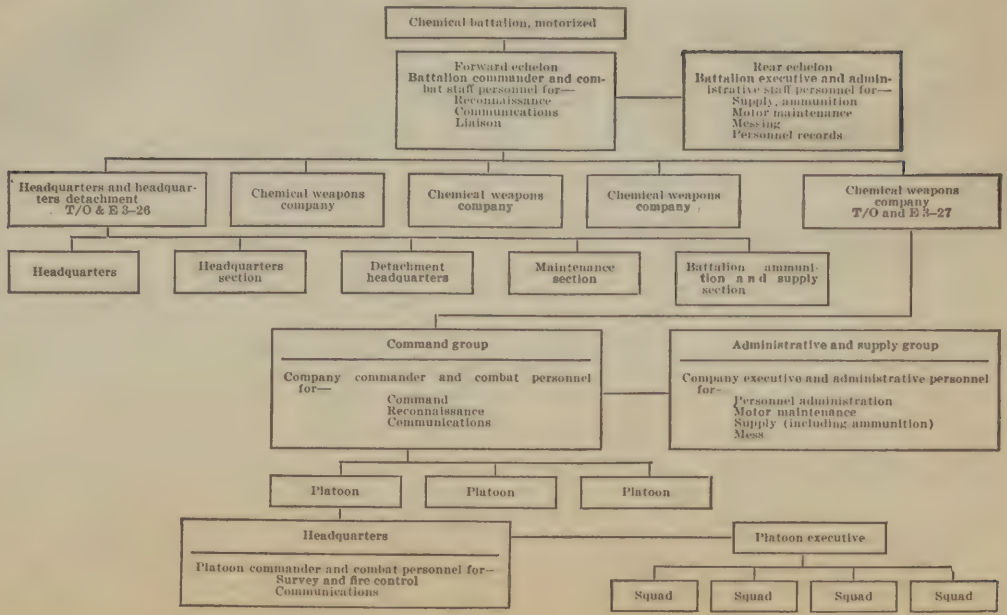
[1] For neutralization. For harassing, use half the quantities given.
[2] Do not fire H below 32° F. Use L.
[3] Rounds per hour.
[4] Below 50° F., increase 25 percent.
[5] Fired in not over 2 minutes.
[6] For point target use 75 percent of number of rounds as for one 200 yard circle.

NOTE.—The discrepancy between number of rounds required per 10,000 square yards for 200 yard circles and for 100 yard square results from gaps between circles when applied as a unit of area measurement.

[A. G. 300.7 (10 Nov 43).] (C 1, 13 Mar 44.)

APPENDIX X (SUPERSEDED)

ORGANIZATION OF CHEMICAL BATTALION, MOTORIZED
(T/O & E 3–25)



■ 3. AIRPLANE MUNITIONS. *a.* (*Superseded*) *Bombs, H.*

	Requirement per square	
	Heavy [1]	Light [2]
M47A2 bomb	16	3
M70 bomb	19	4

[1] Heavy concentration approximately 0.11 pound per square yard.
[2] Light concentration approximately 0.02 pound per square yard.

b. H spray attack.—See FM 1–10.

c. Smoke screen, airplane spray.—See TM 1–282.

[A. G. 300.7 (10 Nov 43).] (C1, 13 Mar 44.)

■ 4. LAND MINES, H FILLED.

* * * * *

[A. G. 300.7 (10 Nov 43).] (C1, 13 Mar 44).

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

U. S. GOVERNMENT PRINTING OFFICE: 1944

CHEMICAL WARFARE SERVICE FIELD MANUAL

TACTICS OF CHEMICAL WARFARE

CHANGES No. 2

WAR DEPARTMENT,
WASHINGTON 25, D. C., 25 September 1944.

FM 3–5, 20 July 1942, is changed as follows:

■ 71.1 PREPARATION OF CHEMICAL OPERATIONAL PLANS (Added). *a.* Chemical warfare staff officers in preparing plans for chemical operations will consider—

(1) The general target area weather forecast.

(2) The micro-weather forecast for the target area, consisting of the vertical temperature gradient (see note below) and the airflow pattern within the 50-foot layer adjacent to the earth's surface.

b. The Army Air Forces Weather Service will furnish to divisions and higher headquarters the two weather forecasts mentioned in *a* (1) and (2) above, together with any other available weather information that may be of assistance in the preparation of the chemical operational plans. Any significant change in weather will immediately be reported to the division and higher headquarters concerned.

NOTE: The vertical temperature gradient is the rate of change of air temperature with change in altitude.

[A. G. 300.7 (10 Aug 44).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

As prescribed in paragraph 9a, FM 21–6 except D (5); B (5); R (5); Bn (5); C3 (15).

For explanation of symbols, see FM 21–6.

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